DEC. 1981 $1.95* NZ $2.50

eti

ELECTRONICS TODAY INTERNATIONAL

check inside

Applied Technology's
EASY USE
Semiconductor Wall Chart

SLOT CAR CONTROLLERS

WIN A SYSTEM 80*

2650 COMPUTER on S100 board

A look at QUAD'S NEW Electrostatics

Particle Beam Fusion

The average hi-fi designer versus the human ear.

The human ear forms part of a sound receiving system that outperforms the best audio equipment known to science.

Capable of interpreting a dynamic range of 120db or 10 octaves, it has double the capability of any man made electronic equipment.

The ear can discern direction, coloration and musical within a complex detail rendition of a 50 piece orchestra in a manner no electronic equip ment is able to do.

It is, in short, a sophisticated piece of equipment that should represent the most stimulating challenge to any designer of audio equipment.

Unfortunately it's a challenge that's largely ignored. Which is why in most stereo

systems handling power and volume are substituted for subtlety and frequency response. Vector Research however is one of the few exceptions. Developed by a team of highly experienced audio engineers who were tired of comprom ise, Vector Research represents a new standard in high fidelity excellence.

Discussing the Vector VRX 9000, *Stereo Review* states "The receiver surpassed virtually every one of its performance specific ations... it sounds as good as it looks, which is saying a lot..."

High Fidelity states "a receiver with such sophisticated per formance and functions demands attention." *Popular Electronics* on the Vector VCX 600 cassette deck, "Lower Flutter readings than those of the VCX 600 are hard to find... while not cheap, it affords excellent value." *Hi-Fi Buyer's Review* sums up.

"Vector Research is a newcomer to the audio scene, but if the VCX 600 is any guide, this company should be very successful."

If then you are an audiophile whose interest goes beyond famous names and shiny knobs then you owe it to yourself to learn more about Vector Research.

Dear V.R., In my book, beauty is in the ear of the beholder. Send me the test reports and the name of my nearest stockist.

Name _____

Address _____

_____ Postcode _____

Keio International Pty. Ltd.
198 Normanby Road, South Melbourne 3205.
Telephone: (03) 64 3546.

KO 404 ETI

Vector Research. A fraction better than excellent.

ELECTRONICS TODAY INTERNATIONAL

Registered by Australia Post — Publication No. NBP0407
ISSN No. 0013-5216

Well, it has been an eventful year for us here at ETI. We put our best foot forward – project wise – right at the start by commencing the Series 5000 hi-fi projects with the 100 W MOSFET stereo amplifier featuring performance unrivalled by *any* published project – or commercially available amp. In February we became the first magazine in the world to review loudspeakers using spectral decay analysis – thanks to the work of Louis Challis. Now we can measure those subtleties you can hear. In March we exposed the fallibility of police speed radars with a detailed examination of their workings never previously seen in the technical press.

April was our tenth birthday issue – and the biggest selling issue for many years! In May we featured a technical review of research work carried out on the Shroud of Turin following examination of it by an international scientific team in October 1978. It was the first such technical review published worldwide, and we gained an enormous amount of attention from the general media as a result.

In June we launched Hobby Electronics which, disappointingly, we had to discontinue as a monthly publication in November. We also launched COMDEC, a computer magazine for business people – which gained immediate success. You win some, you lose some.

In July we commenced the second stage of the Series 5000 projects with the introduction of the Stereo Control Preamp, since widely acclaimed. September saw the start of construction of the long-awaited Learners' Microcomputer – for the first time, a *truly* low-cost computer project aimed at those who want to get into microcomputing without boiling their brain cells or breaking the bank.

October stood out, not only because David Tilbrook appeared on the front cover, but for the ZX81 contest, which attracted what seems to be the greatest number of entries of any contest we've ever run! Results next issue. The November issue represented a 'first' for us – but maybe you didn't notice. The cover featured silver! That's *real silver* in the ink! Stash those precious copies away, there's about three cents worth on each cover – you might make a killing on the silver market when the price rises again!

This month we continue our support of the hobby computerist with another in our series of S100 computer projects – the ETI-685. And there's more to come.

Well, so much for the year in review. Next year? That would be telling. Suffice to say we not only plan to continue our high standard of projects, features and reviews but we'll introduce a few new things as well.

We extend to our readers and advertisers best wishes of the season and trust that you have a prosperous, exciting new year.

Roger Harrison
Editor

QUICK INDEX

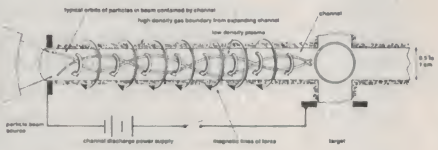
advertisers

eti ELECTRONICS TODAY INTERNATIONAL

Slot cars are fun! . . . for kids of all ages. Jonathan Scott, together with Corey and Jamye Harrison, proved the point for our photographers by converting the studio into a miniature Le Mans (complete with sound effects from the side of the mouth and odd staff making crowd noises to egg them on). You too can join in the fun, commencing page 26.

*Recommended retail price only

features



PARTICLE BEAM FUSION 14

Could particle beam fusion supersede the fission processes of present-day nuclear reactors to provide the answer to world energy requirements? Brian Dance investigates.

WIN A SYSTEM 80 — CONTEST 110

Complete a simple crossword and write a short essay, and a Dick Smith System 80 personal computer could be yours.

news

NEWS DIGEST 8

SUPERFET arrives; Hobbyist toolkits; How not to solder your fingers; Something terrible happened in space; Ideas for Christmas; etc.

COMMUNICATIONS NEWS 67

Oscar 9 flies; Study of radio-induced changes in ionosphere; and more.

PRINTOUT 76

Fluke microsystem troubleshooter; ComputerLand on the Gold Coast; TRS-80 hotline; Apple II Users' Guide — book review; Sanyo display screen easy on the eyes; etc.

SIGHT & SOUND 127

Blank tape levy inquiry; ITT digital television; four-hour VHS cassettes; National Panasonic low-light camera; Will the videodisc survive?; etc.

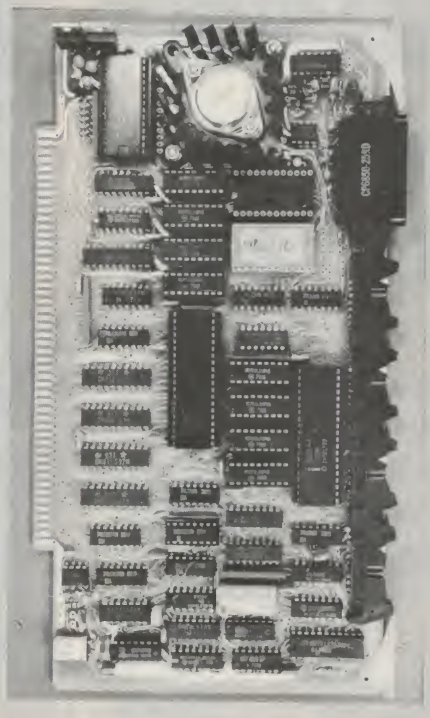
projects

824/825: SLOT CAR CONTROLLERS 26

Hours of fun for electronics enthusiasts and their families — invest in a cheap slot car set and turn it into your version of Le Mans! For once your family won't moan about your hobby!

159: EXPANDED SCALE VOLTMETER 37

This simple, low-cost instrument can be built into power supplies or used as a portable or fixed battery condition monitoring meter.



computing

sight & sound

general

next month

SATURN UP CLOSE
Voyager 2's flyby of Saturn in late August/early September gave us our closest look yet at this fascinating planet. Passing 101 000 km from the cloud tops, Voyager 2 showed that Saturn's rings number in the thousands, rather than the few we thought existed – even though Voyager 1 picked up hundreds in its 1980 flyby.

January's science feature shows some of the spectacular detail obtained by Voyager 2's cameras and discusses the scientific achievements of the mission.

LASERS & HOLOGRAPHY
A major laser and holography exhibition will tour Australia next year. Called 'Space Light', it will spend all January in Sydney before touring major centres in the other states. Our article previews what it's all about.

INFRARED TRIP RELAY
A simple, low-cost project that operates a relay when a beam of infrared light is broken. Useful as a 'door minder' alarm or to trip a camera for wildlife photography, etc, this project is easy to get going and will only set the budget back by about $25.

REVERSING ALARM
There are a number of accidents reported each year where a child or adult has been seriously injured by a vehicle being driven in reverse. There would be countless potentially serious near misses. A reversing alarm that operates when you select reverse gear would obviously help prevent the number of 'incidents'. The project is inexpensive, provides a loud, audible 'beep', and is easy to fit. A must for the safety conscious.

SPEEDY BASIC
How to improve your programming by writing programs that operate more efficiently. No matter which BASIC you're using . . .

DOLBY C EXPLAINED
The brilliant Ray Dolby has waged an indefatigable war against noise in audio systems, and with not a little success. His latest weapon is examined in detail.

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

DIRECT IMPORT

NEW ZEALANDERS

TAKE ADVANTAGE OF DICK'S LOW PRICES

DIRECT IMPORT

INCREDIBLE SYSTEM 80

We're proud to offer this exceptional computer to our New Zealand customers. These are just some of the features: 16K memory, S-100 expandable, compatible with almost all level II programs, works with any standard TV set, has built-in cassette deck level control. Quite simply it represents outstanding value for money.

$NZ

ONLY $1195

X-4005 P&P.$5.50

WE HAVE BUSINESS, & EDUCATIONAL & GAMES SOFTWARE IN CASSETTE OR DISK FORM - SYSTEM 80 /TRS 80.

Here is a small part of our range

GENERAL LEDGER: There are many general ledger systems around, but few designed with the small businessman in mind. We believe it to be far superior to any other on the market today. X-3752 $499.

WORP-9: An incredibly versatile word processor that provides a host of features including unlimited text insertion - ability to print mailing labels & merge name & address file with a standard form letter. X-3761 $499.

TYPING TUTOR: An interactive program that teaches you to touch type. Claimed to teach typing skills faster than any other method. X-3682 $33.50.

SPEED READING: 4 programs, 2 cassettes, designed to help readers of all ages improve reading skills. Reading speed can be set as high as 0.1 seconds per line. X-3692 $33.50.

SIMUTEK PACKAGE ONE: Five fantastic space fantasy games in one. Outstanding value! X-3685 $29.95.

DIRECT IMPORT

3.5 DIGIT LCD DIGITAL MULTIMETER

This 20 range multimeter offers exceptional performance, together with a highly legible liquid crystal display for very low power consumption. And unlike other digital multimeters on the market, this model has overload protection. It's very easy to use, and will give years of service. A must for the hobbyists, technician or engineer.

SAVE $20!

ONLY $75 $NZ

Q-1450 P&P.$4.00

FANTASTIC FLASHING LED

ONLY $1.98

Amazing! This 5mm RED LED can be used in dozens of applications where a flashing warning is needed. Z-4000 P&P.$1.00

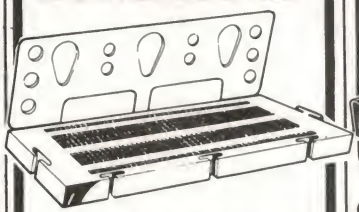
GRADUATED EDGE METER

32(W) X 10(h)mm, is ideal for fine level adjustments. $NZ $4.98

Q-2110 P&P.$1.00

DIRECT IMPORT

Hobbyists & experimenters- highly versatile BIMBOARD



The modern way to build up circuits without resorting to PCB or tag strip. Over 500 sockets that will accept component leads of 0.25 to 0.85mm, spaced 2.54mm. Designed to carry up to 1 amp. The board is even supplied with a component mounting panel for pots etc. They can be connected together to make up larger units.

ONLY $NZ $29.95

P-4612 P&P.$3.00

TURN YOUR OWN TV INTO A CRO!

This remarkable kit turns any surplus B&W (or color) TV into a 30kHz audio oscilloscope. It is ideal for Hi-Fi and audio display applications.

ONLY $NZ $37.95

K-3060 P&P.$3.00

DIRECT IMPORT

BUILD YOURSELF CAPACITOR DISCHARGE IGNITION

One of our most popular kits we've ever sold! This unit fits on any conventional ignition system. Results other customers have obtained: engine stays in tune much longer, plugs & points last longer, car is much easier to start.

ONLY $NZ $47.50

K-3280 P&P.$3.00

COMPARE OUR PRICES FOR QUALITY COMPONENTS

¼W metal film resistors 1% tol. any value - all one price.	6cea.
¼W carbon film resistors any value - all one price.	4cea.
½W carbon film resistors any value - all one price.	5cea.
1W carbon film resistors any value - all one price.	8cea.

SAVE ON DICK'S BULK PACKS!

RESISTOR PACK: 300 computer selected ¼W types worth $20.00 (R-7010).	$7.50
ELECTROLYTIC PACK: 55 electros, at least $16.00 value. (R-7030).	$8.50
CAPACITOR PACK: 60 Greencaps, at least $13.00 value. (R-7040).	$8.50

DSE/A094/LM

DICK SMITH ELECTRONICS

98 Carlton Gore Rd. Newmarket
Auckland 1. Ph. (Auckland) 50 4408 50 4409

MAIL ORDER CENTRE: Address as above.
STORE HOURS: Monday to Friday 8.30am to 5pm.

Call into our store and collect your copy of our catalogue!

ARON

SCOPES FOR PROFESSIONALS

sold and serviced by ELMEASCO and leading electronics suppliers.

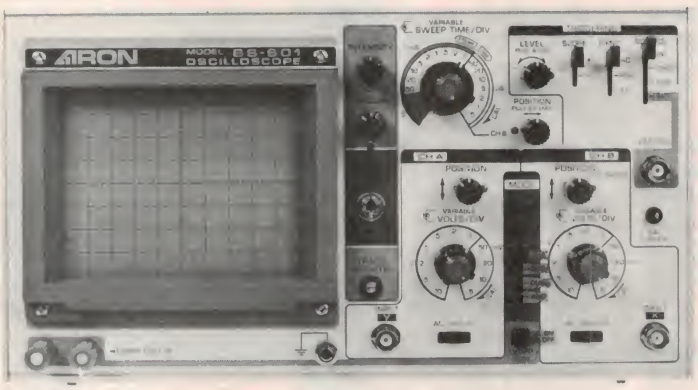
45MHz/1mV Model BS625 with Signal Delay★

- *Fast 7.7nS risetime*
- *Single sweep*
- *Trigger delay*
- *TV sync*
- *Z modulation*
- *Channel B invert*
- *Variable graticule illumination*
- *Trace rotation*
- *X-Y operation*
- *Weighs only 9.8kg*
- *150mm metal-backed PDA rectangular tube*
- *High 15kV accelerating voltage*
- *Channel A, Channel B, Dual, Chopped, Alternate switch selectable*

$1245.00

★*Signal Delay*. A delay line is incorporated in the signal circuitry so that signals can be displayed, in effect, before the trigger point. This is an essential feature when investigating the rise time of pulses. It allows the leading edge of the wave form to be examined.

20MHz/5mV Model BS601



- *5mV/div to 10V/div in 11 ranges*
- *20MHz bandwidth, 17nS risetime*
- *Timebase 0.5uS to 0.5S/div in 19 ranges*
- *Dual Trace - CHA, CHB, Dual, Add, Subtract modes*
- *5x Magnifier on sweep*
- *150mm bright rectangular CRT with internal parallax-free graticule*
- *X-Y operation and Z modulation*
- *T.V. sync*
- *Front panel trace rotate*

WITH BUILT-IN COMPONENT TESTER AT NO EXTRA COST!!

Find faults faster... check component values... see characteristics on the screen.

$550.00

ARON

All prices are plus sales tax if applicable

ELMEASCO

Instruments Pty. Ltd.

P.O. Box 30, Concord, NSW. 2137
13-15 McDonald St., Mortlake, NSW.
Phone: (02) 736-2888, Telex: 25887

P.O. Box 107, Mt. Waverley, Vic. 3149
21-23 Anthony Drive, Mt. Waverley, Vic.
Phone: (03) 233-4044. Telex: 36206

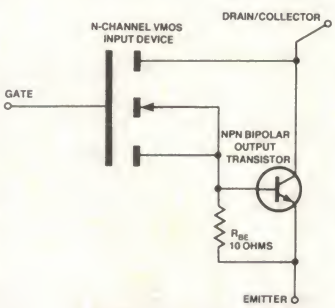
Adelaide: (08) 271-1839 Brisbane: (07) 229-3161 Perth: (09) 398-3362

NEWS digest

It's a chip, it's a what? — it's a SUPERFET!

A new monolithic device which allegedly has the advantages of VMOS devices combined with the high current handling capability and low saturation voltage of a bipolar transistor has been developed by Supertex Inc of California, and is claimed to offer considerably better switching performance than existing products.

The internal circuit of the SUPERFET, shown here, consists of a VMOS input device — which provides an extremely high input impedance, a current gain of perhaps a hundred million and a very fast switching capability — and a bipolar output transistor specially designed to preserve the fast switching ability.



A 10 ohm resistor is connected between the base and emitter of the bipolar output transistor to prevent the device from being turned on by spurious transient signals. In fact, this resistor consists of 32 separate resistors connected in parallel to preserve the fast switching capability, while the output transistor has many small emitter regions connected to two output pads. The input VMOS transistor occupies about 40% of the area of the 6.5 mm by 6.2 mm chip.

The Supertex XN01 was the first SUPERFET described in a paper given at the US Powercon Conference recently. It consists of an n-channel enhancement mode DMOS power FET and an npn high current, high voltage power transistor.

It is a really high power device, available with voltage ratings from 350 V to 500 V, and can pass a continuous drain current of 20 A (40 A when pulsed) with a power dissipation that can reach 150 W.

A particular feature of this device is that a drain-emitter voltage of only 6 V can be used to produce the maximum current of 20 A. It is claimed that the saturation voltage of the SUPERFET is lower than that of any comparable power MOSFET device. Resistive switching speeds are comparable with those of power MOSFET devices and more than twice as fast as those of a comparable 450 V, 20 A power Darlington device.

Device Type	Max. Drain-to-Emitter Voltage BV_{DES}	Drain-to-emitter Voltage V_{DE}	Current when Conducting
XNO135N1	350 V	6 V	20 A
XNO140N1	400 V	6 V	20 A
XNO145N1	450 V	6 V	20 A
XNO150N1	500 V	6 V	20 A

Summary of XNO1 device categories; all are in TO-3 packages.

Incidentally, it is not possible to make a circuit with the performance of a SUPERFET by connecting a VMOS device to a high-power bipolar transistor. The switching speeds of the available VMOS and bipolar devices are similar to or worse than that of the SUPERFET, while parasitic lead inductances in the connections to the two devices would drastically limit the operating speed.

Supertex has stated that even if devices with a faster switching capability should become available, it will not be possible to use them to match the performance of the SUPERFET owing to the lead inductances.

As in the case of all enhancement VMOS devices, the SUPERFET will be non-conducting at zero gate voltage (maximum current 10 mA at 25°C or 100 mA at 125°C). A positive potential applied to the gate will turn the device to its conducting state.

Applications of the SUPERFET are expected to lie mainly in fields where fast switching is needed at high power levels (e.g: switch mode power supplies). This device is likely to be much used in switched mode power supply units for higher frequencies than can easily be handled by high-power bipolar discrete transistors. Devices which will operate at 200 kHz or more are required for this purpose. Another application is in the field of ac motor control.

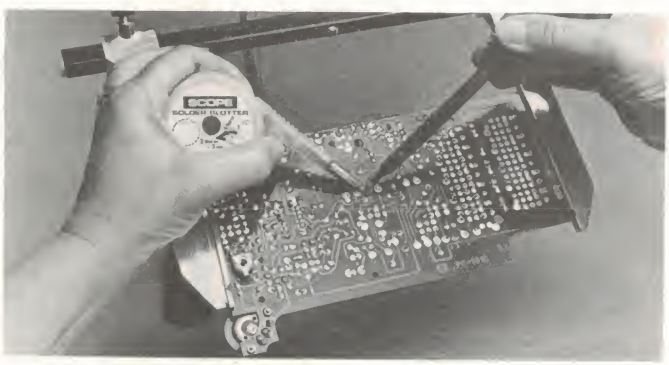
Brian Dance

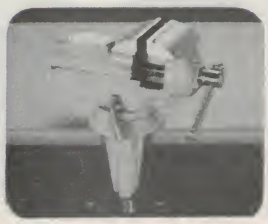
Don't solder your fingers

Scope Laboratories now have available a dispenser pack for desoldering braid which helps you avoid burnt fingertips — no longer do you have to hold the braid close to the working area and the hot iron.

The new pack is claimed to accurately position the braid, even in tight and awkward spots, and lets surplus braid be easily rewound. The dispenser, called the 'Scope Solder Blotter', also holds 30% more braid than most conventionally packed braids, but the two-metre roll is said to be nevertheless competitively priced.

For further details, contact Bev Evans, Scope Laboratories, 3 Walton St, Airport West Vic. 3042. (03)338-1566.





Cheaper housing!

Individually styled plastic housings for electronic and scientific instrumentation, computers, business machines, etc, can now be custom-designed and manufactured without the high tooling and die costs normally associated with conventional moulding processes.

A new service offered by Aegis Pty Ltd of Melbourne utilises vacuum forming and fabrication techniques, which afford the designer virtually all the facilities of conventional moulding, but tooling costs are in the order of only a few hundred dollars as compared to the several thousands of dollars normally incurred.

The process makes use of versatile ABS plastic sheet, which lends itself readily to forming into a myriad of shapes and styles and in the finished state is lightweight, durable and highly impact resistant.

The service is expected to be of particular advantage to manufacturers of specialised equipment in the low to medium-volume field, where a professional presentation is required without high initial capital outlay.

For further information contact Sigea Australia (Marketing Division of Aegis Pty Ltd), 141 Christmas St, Fairfield Vic. 3078. (03)481-1422; telex: AA34225.

Natsemi changes distributors

National Semiconductor (Australia) has announced that it is switching all its distributor business from ICS Pty Ltd and RIFA Pty Ltd, retaining Semtech NSW Pty Ltd and appointing a new company, NSD Pty Ltd, to handle its product lines.

NSD is headed by two top salesmen from ICS and RIFA, both of whom have had wide experience with Natsemi products. Mr. Kerry Kelly from ICS will head NSW sales, and Mr. George Stockman from RIFA will look after Victorian distribution.

National Semiconductor explained the change: "In both New South Wales and Victoria the distributors were not only competing with one another but also each carried their own competitive semiconductor lines. We were not content that ICS and RIFA were giving our product the level of exposure and thrust we wanted. The new arrangement gives us a much stronger marketing arm."

It is hoped to develop the design-in side of the business under the new arrangement, whereby NDS will design components to order for customers.

Hobbyist toolkit

A good set of workshop tools can make all the difference between a hassle and a pleasure when it comes to doing the mechanical construction work for electronic projects.

Good tools can also make the difference between 'just a job' and a 'professional finish' on that project.

Minitool Australia recently introduced a series of small-scale electrically operated tools and tool kits that are just right for the hobbyist — particularly beginners and youngsters.

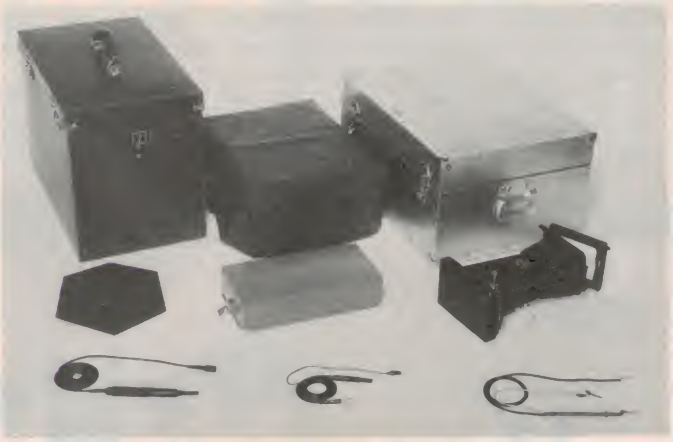
All the tools operate from a 12 Vdc source — battery or suitable plugback or dc power supply. Amongst the tools are: a pistol drill that takes drill bits from 0.8 mm to 6 mm diameter (just right for pc boards, jiffy boxes and small front panels); a jigsaw with a cutting depth to 7 mm (the saw has a blunt tip to protect against injury); an orbital sander and a drilling stand. In addition, you can attach a flexible shaft to the drill and a chuck on the opposite end to hold all sorts of accessory tool bits — like drills, milling cutters, grinding bits, wire brushes, etc, etc.

All in all, the Minitool range looks very comprehensive and would prove most useful to the hobbyist who wants to make his or her work less of a hassle and to produce more of a 'professional' job.

Two workshop 'kits' are available. The larger, Kit 000-62-90X, includes a power supply (12 Vdc plugpack), pistol drill, drill stand, orbital sander, flexible shaft unit, table clamp, platform table, jigsaw, spare blades and a very handy carry case — all for $250 (rrp). The 000-62-90Y Kit does not include the flexible shaft unit and is priced at $199 (rrp).

Look for the exciting competition with a Minitool Workshop kit and tools as prizes in a forthcoming issue of ETI.

More details on the tools can be had from Minitool Australia, 134A Ayr St, Doncaster Vic. 3108. (03)850-9887.



Range of accessories from BWD

Complementing the wide range of professional instruments manufactured by BWD Instruments Pty Ltd is an equally wide range of accessories to be used with BWD's oscilloscopes, power supplies, function generators, etc.

The range includes probes, cameras, carrying cases, dust covers, protective front covers and viewing hoods. Each product is manufactured for or by BWD to their own specifications, and considerable attention is said to be given to convenience of use, safety and weight.

For further information contact BWD Instruments Pty Ltd, Miles St, Mulgrave Vic. 3170. (P.O. Box 325, Springvale Vic. 3171). (03)561-2888; telex: 35115.

NEWS digest

Ideas for Christmas

Tandy Electronics has come up with a few answers to that age-old plaint: "Whatever can we buy so-and-so for Christmas?"

Tandy's gifts cover all ages, starting with a good idea for teaching young schoolchildren to calculate with Radio Shack's EC-351 Child's Learning Calculator. This comes with an easy-to-understand booklet and is supposed to make even arithmetic fun. It'll cost you $12.95.

For kids to use as a 'lie detector' or adults who have trouble relaxing, Tandy's 'Biofeedback Monitor' has two probes which clip to your fingers and measure your stress level by judging your skin resistance. The trick is to make the tone from the monitor's loudspeaker change by relaxing. Such a gadget will set you back $18.95.

There are cuddly toys with AM radios inside them, priced upwards from the 'Cuddly Cat' at $14.95, and for more advanced music lovers there is also the Stereo-Mate AM/FM radio with micro headset for use while walking, working, exercising, etc. It goes for $64.95, while for $99.95 you can get the mobile SCP-4 Personal Stereo Cassette Player and listen to your own choice of music.

You can get hours of fun, thrills and developing skills driving one of Tandy's radio-controlled toy cars, which can be bought with a range of features; there are even tanks and motorcycles. Prices range from $16.95 to $89.95, depending on how sophisticated the remote control system is on the model chosen.

The Tandy 'Electronic Computerised Arcade' is twelve action-packed electronic games in one, costing only $39.95. Children — and the rest of the family, no doubt — can compete at baseball, gamble on roulette, guess unknown colours, fire torpedoes to sink enemy ships, or shoot missiles to bring down alien spacecraft. It's even a twelve-note organ you can compose songs on as well! And if you're still having trouble deciding what to buy, have a go at Tandy's 'Executive Decision Maker' for $14.95. You ask it a question and press a button, whereupon one of six randomly chosen replies will be indicated, ranging from 'definitely' to 'forget it'. Give one to your managing director or local politician and help make their lives easier!

As well as such toys and gadgets, the new Tandy catalogue contains almost 2500

other products ranging from microcomputers to security systems, stereo systems to clocks and radios, plus of course all the tools, hardware, electronic parts and accessories that the name of Tandy is automatically associated with.

Don't miss your copy of the catalogue — it's free at any Tandy store.

LED catalogue from Philips

Available from Philips Electronic Components and Materials is a new short-form catalogue detailing more than sixty types of LED circuit board indicators. Highlighted are red, green and yellow LEDs, QUAD-LED four-element arrays, and bicolour.

Illustrated with photographs and dimensional drawings, the catalogue provides complete product descriptions and specifications. Particularly handy is a product selector chart.

To receive this catalogue (75-CBI-8100), contact Sales Department, Philips Electronic Components and Materials, 67 Mars Road, Lane Cove NSW. (02)427-0888.

Regency®

scanners

...action as it happens

A choice of 3 scanners — for use at home or on the go!

Vicom International Pty. Ltd.

57 City Road
South Melbourne
Victoria, 3205
Phone (03) 62 6931

339 Pacific Hwy.
Crows Nest. NSW.
2065
Phone (02) 436 2766

Authorised Dealers

N.S.W.
Newcastle: Elektron 2000 26 2644
Wagga: Rivercom 21 2125
W'Gong: Macalec 29 1455

Queensland
Brisbane: CW Electronics 397 0808
Cairns: GCG Communications 54 1035
Gold Coast Amateur's Paradise 32 2644
Townsville: Robco Equipment 72 2633

Victoria
Melbourne Eastern Communications 288 3107
Moe: Codlin Communications 27 4516
Hamilton: Hamilton Electronics 72 3333
Ballarat: Wecam 39 2808
Frankston: World Wide Radio 789 3412

South Australia
Adelaide: Compucom 43 7981
I.C.S. 47 3688
Mt. Gambier Set Services 25 2228

Western Australia
Perth: Willis Electronics 21 7609
Netronics 46 3232
Kalgoorlie: Hocks TV 21 1906

Tasmania
Launceston: Gelston 44 3882
Advanced Electronics 31 7075
Hobart: Harvey Skegg 47 6674
Burnie: VK Electronics 31 1708

VICOM

Model M100

The 10 channel, no-crystal scanner!

FEATURES:
- No crystals required
- 10 Channels
- 6 Bands
- All frequency search
- Priority
- 10 programmable R.A.M. Channels
- Search Hold to stay with important frequencies
- Search and scan delay
- Manual, Search or Scan Control
- Custom frequency-synthesized circuitry
- AC supply and DC cord supplied
- Detachable, swivel telescope antenna supplied
- Attractive, durable case
- Top-mounted speaker
- Regency quality and reliability

$399

Model H604E

The hand-held scanner gives you the action wherever you go.

FEATURES:
- 6 Channels - so you'll hear all the action
- 4 Bands - LoVHF, HiVHF, UHF, UHF-T
- Advanced circuitry - combines small size with great performance
- L.E.D. channel indicators - bright and long lasting
- Channel lock-outs - select only the channels you want to hear
- Step Control - advance channels one at a time
- Two Antennas - Flexible antenna and wire antenna included

$169

price does not include crystals

Model M400

Hear all the action on 30 channels covering over 15,000 frequencies.

FEATURES:
- No crystals required
- 30 Channels
- 6 Bands
- All frequency search
- Priority
- Digital readout quartz clock
- 30 programmable Channels
- Search Hold to stay with important frequencies
- Quartz elapsed time clock records up to 100 hours
- Programmable Search increments
- Search and scan delay
- Manual, Search or Scan Control
- Custom frequency-synthesized circuitry
- AC supply and DC cord supplied
- Detachable swivel telescope antenna supplied
- Nickel Cadmium memory battery included
- Attractive, durable case
- Top-mounted speaker
- Regency quality and reliability

$449

NEWS digest

Something terrible happened in outer space . . .

Astronomers have just discovered that something really terrible happened way out in space some time ago, but they don't know yet where it was, when it was, how terrible it was or even quite what it was.

Examination of a backlog of recordings made in Earth's orbit four years ago by the first high-energy astronomy observatory has revealed a burst of gamma rays, indicating a catastrophic event far out in space. The burst was followed by half a minute of 4.2 second reverberations, suggesting its probable association with a superdense neutron star rotating at that rate.

Only one other such reverberating gamma ray burst has been recorded, on March 5 1979. The newly discovered event was actually recorded on October 29 1977.

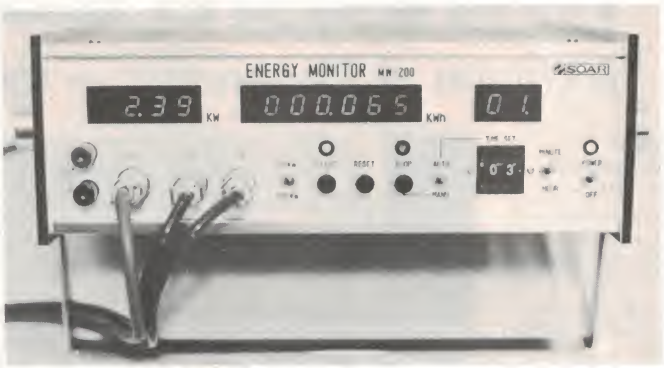
The 1979 burst was detected by nine spacecraft scattered about the solar system. By comparing precise arrival times of the burst at each of them, it was possible to determine that it came from the direction of a large Magellanic cloud, a small galaxy of stars about 200 000 light years away, not far from the outer fringes of the Milky Way. If the source was indeed that far away, within seconds it must have emitted as much energy as the stars of the Milky Way combined.

Many astronomers believe that the source of this 1979 burst was a neutron star within that star cloud. A neutron star is formed when a large star exhausts its nuclear fuel, cools and collapses into an object of extremely small size, high density and rapid rotation.

The newly recognised 1977 event was recorded by X-ray detectors placed on the orbiting observatory by the American Naval Research Laboratory under Dr. Herbert Friedman. The detectors were able to record the burst because, although it was primarily in gamma rays, it overlapped the X-ray spectrum. The rays were too weak for recording by other spacecraft, and hence the direction of the source has not been determined.

The suddenness and violence of the 1979 event were difficult to explain. It soared to full power in only twelve hundredths of a second, then tapered off in the next three minutes, reverberating at an eight-second rate. One suggested explanation was that a comet fell on a neutron star rotating every eight seconds; another that an asteroid fell on the star. About 96 000 km out the asteroid would have begun to disintegrate under the influence of the neutron star's extreme gravity, stretching into a long trail of debris. This debris would have encircled and fallen on the star, approaching the speed of light, and, in one billionth of a second, becoming heated to two billion degrees Fahrenheit. This could have generated the sharp pulse of gamma rays.

However, the newly discovered 1977 burst does not fit this model, according to Dr. Friedman. The two-second time required for the pulse to reach full power is not compatible with an almost instantaneous impact. One possibility, he added, might be that material that had accumulated in orbit around the star had fallen on it when perturbed in some manner. Another explanation could be sudden contraction or some other form of extremely massive transformation within the star.



Energy monitors from Soar

GFS Electronic Imports now have stocks of two new Soar energy monitors, designated MW-200 and MW-200SD. According to GFS, these will allow accurate measurement of electrical consumption of individual machines on electrical circuits, enabling manufacturers to determine precisely running costs of the particular areas under measurement.

Using this facility, GFS claim that manufacturers will be able to price their products more competitively as well as increase their profits by isolating areas of high electrical energy consumption and then streamlining the operation of these areas to reduce energy usage.

Made by the Soar Corporation of Japan, the range of monitors consists of two digital readout models. Both are designed for easy installation and make use of magnetic pick-up probes which simply clamp around the power cables of the machine or area to be monitored.

Top of the range is the MW-200, which features both an accumulated kilowatt/hour readout as well as a separate instantaneous kilowatt power readout. Both models incorporate an automatic timer which allows measurement to be taken over two ranges — 1 to 99 minutes or 1 to 99 hours — with a maximum reading of 100 000 kW/hr in two ranges.

For further information contact GFS Electronic Imports, 15 McKeon Rd, Mitcham Vic. 3132. (03) 873-3939; telex: 38053.

ERRATA & OMISSIONS

Series 5000 Preamp, Oct. '81. The 400 Hz oscillator procedure was omitted. It's simple. Take your multimeter, set to read ac volts, and connect it between the wiper of RV4 and 0 V. Set RV4 to obtain 1.2 Vac (RMS).

Note that R52 and R53 on the overlay are shown as 220R when they should be 220k as per the circuit and parts list.

ETI-660 Learner's Micro, Nov. '81. On Overlay Drawing #5, p.32, the link near IC8 is shown as LINK 2 when it should be LINK 3. On the circuit, pages 36-37, the designations for diodes D5 and D6 are reversed. The **upper** diode is D6. The note relating to D5, D6 is correct.

Programming in CHIP-8, Nov. '81. The procedure for loading on cassette (in box, p.116) has an omission. The load procedure should read:

'RESET'
'0'
'STEP'
'0400'
'06'
'STEP'
'00'
'STEP'
'07'
'STEP'
'25'
(or you could put FF here)
'RESET'
'4'

JAVELIN™

ATTENTION CCTV USERS

Announcing the first ever Javelin clearance sale of discontinued and surplus stock items.

Cameras Monochrome Model MV824A, 24VAC 50Hz power
12 only at . . . $283.00 each

Lenses JA1616BNR 16mm f1.6 C mount, no iris
(some not in original cartons) 50 only at . . . $12.75 each

Video Switchers

MS4D Manual 4 way push button 7 only at . . . $86.70 each
MS6D Manual 6 way push button 9 only at . . . $117.30 each
LMS6D Looping manual 6 way push button 4 only at . . . $146.63 each
LIHSS4D 4 way looping homing sequential 4 only at . . . $289.43 each
LIHSS6D 6 way looping homing sequential 5 only at . . . $345.53 each
Some 19″ racking brackets available at . . . $35.70 per set
All above switches will handle video to 10MHz bandwidth.

Vidicons/Picture Tubes

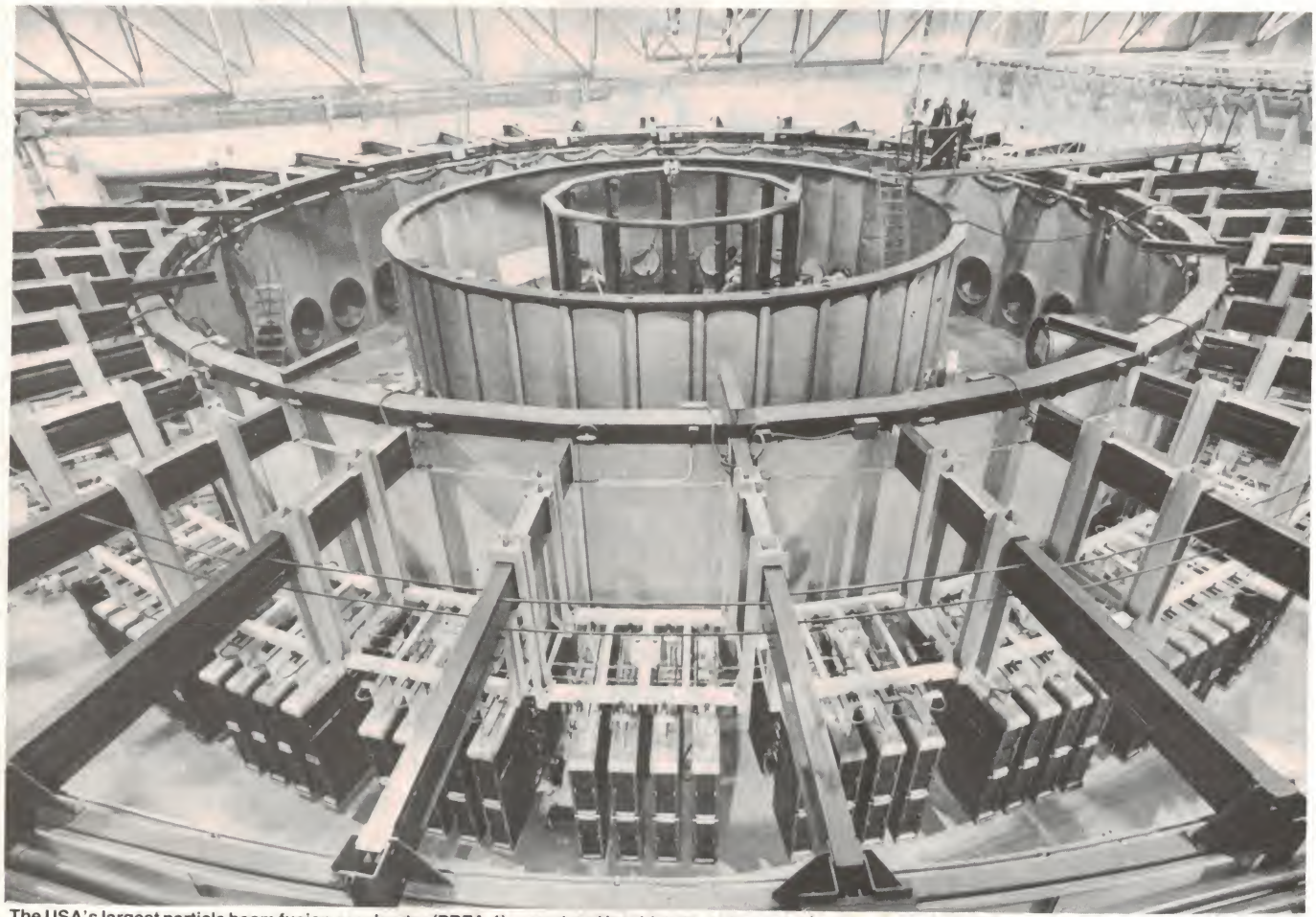
20PE14A (4848) vidicons, 20 only at . . . $77.78 each
CT531 Picture Tubes, 5 only at . . . $79.05 each

Allow $4.00 post & packaging per item

NB: Goods on sale only while stocks last on a first in, first served basis — payment must accompany order.
All prices include sales tax where applicable.
Please send stamped self addressed envelope for any data sheets required.

JAVELIN ELECTRONICS (A/ASIA) PTY LIMITED
15-19 Boundary Street, Rushcutters Bay, NSW 2011 P.O. Box 588, Potts Point NSW 2011
Telephone: Sydney (02) 33 0966 Melbourne (03) 699 8721 Brisbane (07) 262 7545

Particle Beam Fusion



The USA's largest particle beam fusion accelerator (PBFA-1), completed in mid-1980, at Sandia Labs, Albuquerque. It is 30.5 m (100ft) in diameter and produces 36 ion beams, subjecting fuel pellets to a total power of 30 trillion watts.

There are two basic ways in which nuclear energy can be released from matter — by fission and by fusion. Will particle beam fusion supersede the fission process of our present-day nuclear reactors to provide the answer to world energy requirements?

Brian Dance

IN PRESENT-DAY nuclear reactors, heavy atoms (uranium and plutonium) divide into two parts to form lighter atoms together with neutrons and energy; the neutrons then cause more of the heavy atoms to divide. This is the fission process that was also used in the early nuclear weapons used at Hiroshima and Nagasaki. Unfortunately, as became tragically apparent, fission produces much highly radioactive waste.

Fusion

The second possible technique is the fusion process, in which light atoms (particularly hydrogen) fuse together to form heavier atoms. The main problem in harnessing the fusion reactions to produce useful power is that these reactions will only occur at very high temperatures (hundreds of millions of degrees Celsius), since only at such temperatures do the nuclei of the atoms have enough energy to come together in spite of the mutual repulsion of their positive charges.

The sun and stars obtain their energy from fusion reactions. Hydrogen bombs also use fusion to liberate energy, but they require a fission bomb as a 'match' to heat up their nuclear fuel to a temperature at which the fusion reaction can commence. The fission bomb and the neutrons produced in the fusion reaction produce much radioactivity, which appears as 'fallout', but in any case one certainly would not wish to try to use a hydrogen bomb as a source of useful energy!

During the past thirty years man has therefore undertaken intense research to try to 'tame' the hydrogen bomb so that controlled thermonuclear power could be obtained using cheap fuel without the production of much radioactive waste. Unfortunately this problem has proved to be one of the most difficult projects ever tackled, although the possibility of obtaining large amounts of energy at a relatively low price is enormously attractive.

In the 1950s the United States, the USSR and Britain were all carrying out

work using electrical discharges of very high currents through gases to try to produce the high temperatures required for thermonuclear fusion reactions to occur; the writer was involved in this work at that time. Initially the work was highly classified, owing to the importance of cheap power to a nation, but it was de-classified towards the end of the 1950s as it became clear that a very long time would pass before much useful power could be obtained from fusion reactions.

Basically the idea is to confine a plasma of ionised gas at a very high temperature in a 'magnetic bottle' so that it cannot touch any solid material which could take away much heat and reduce the reaction speed. All materials are gases at temperatures at which thermonuclear reactions can occur, so it was proposed that a magnetic field be used to keep the gases together whilst the reaction took place. Work on magnetic confinement is still being intensively continued in the United States, in the USSR and in Europe. The European efforts are now concentrated in the Joint European Torus (JET) project at Culham in England, since the cost is so high that it is best shared amongst the participating nations.

Thus in spite of thirty years of intensive research, man is still a very long way from being able to use fusion reactions to provide him with a convenient source of controlled and cheap energy. However, as our energy problems have become increasingly more severe during the last few years, work on controlled thermo-nuclear fusion has been intensified and a second technique has been evolved for attempting to keep the nuclear fuel together at a temperature of some 300 million degrees for long enough for it to react.

Inertial confinement

In the second technique, known as inertial confinement, the fuel is contained inside a small spherical pellet which has outer layers of metal or glass. The pellet is heated very rapidly by a laser beam or by a particle beam; the outer heated layers expand rapidly outwards and the force of reaction causes the remaining material to be rapidly radially accelerated inwards; the compression causes a temperature rise. If the temperature rises to about 300 million degrees whilst the fuel pellet is compressed to a density of hundreds of times that of a typical solid, a reaction with a duration of the order of 1 ns will occur and produce a very intense burst of thermonuclear energy in the form of neutrons, ions and X rays. Successive pellets would be irradiated to obtain more bursts of energy.

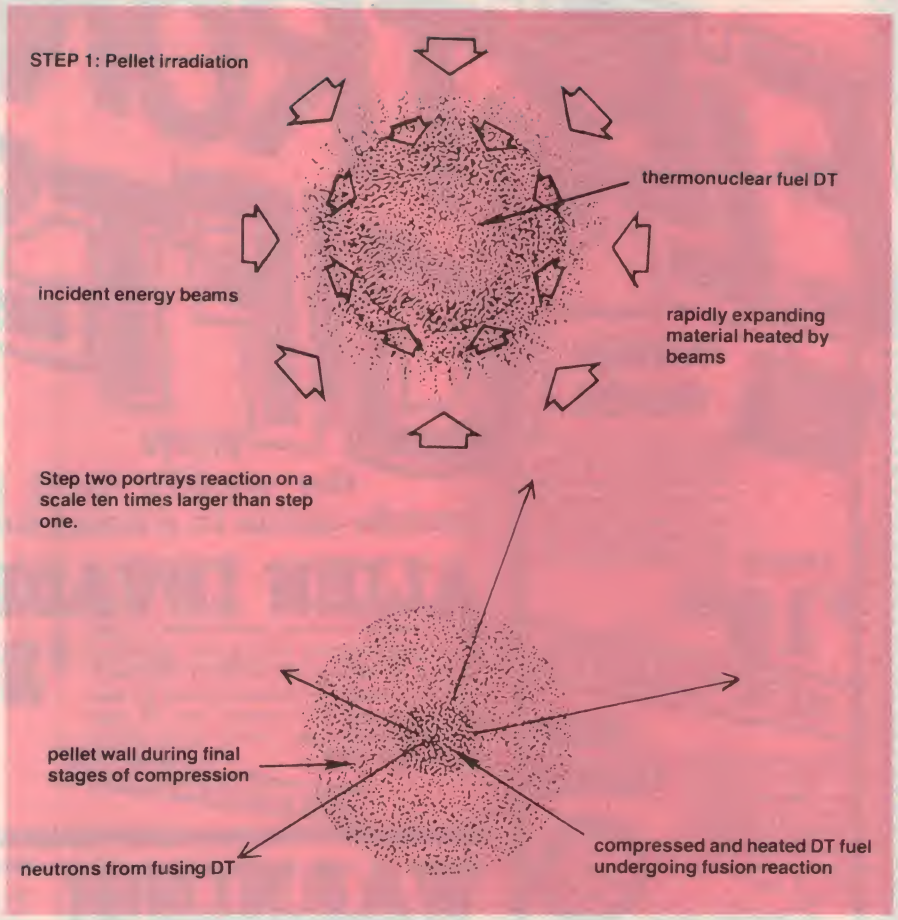


Figure 1. **The thermonuclear fuel of the pellet imploded by external radiant energy.**

The fuel pellets which it is proposed to employ in inertial confinement fusion work are a few millimetres in diameter. In order that the thermonuclear fuel containing deuterium and tritium at the centre of the pellet shall be adequately compressed and heated, as depicted in Figure 1, it is necessary to deliver a very intense pulse of energy to the outside layers of the pellet, this energy being delivered from all sides of the pellet simultaneously. Thus very powerful and specialised equipment is required. Let us look how work on nuclear weapons in the United States may contribute to the peaceful generation of thermonuclear power.

Sandia Laboratories

The Sandia Corporation, a subsidiary of Western Electric, operates the Sandia Laboratories at Albuquerque, New Mexico, on a non-profit basis for the United States Department of Energy. The primary work of the 7600 employees is in research and development for nuclear weapon systems, but about 120 people are working on inertial confinement — probably the largest group in the world in this field.

In the early 1960s Sandia Laboratories were engaged in the use of pulsed intense radiation environments for the testing of the resistance of United States nuclear weapons to the radiation from any enemy nuclear bursts nearby. For this purpose a series of electron accelerators was constructed, ranging from a 300 kV Nereus accelerator to a huge 12 MV Hermes II in the later 1960s. Inertial confinement calculations indicated that the expertise available at the Albuquerque pulsed radiation facilities was especially suitable for investigating the possibility of developing a reactor using the inertial confinement principle.

An accelerator project costing some US$14 million was completed in mid-1980. Originally named Electron Beam Fusion Accelerator (EBFA), since it was designed to produce intense pulsed beams of electrons, this accelerator has been renamed Particle Beam Fusion Accelerator (PBFA-1), since light ion beams are more attractive than electrons for inertial confinement work.

This accelerator is over 30 m in diameter and will produce 36 separate ion beams converging radially inwards towards a fuel pellet. It is the largest pulsed power accelerator in the world and will deliver about 30 x 10^{12} W or about 1 MJ (1 megajoule) to a pellet in ▶

ELECTRONIC GIFTS

WORLD CLOCK

Ever missed a 'sked'? With this superb world clock that can give you accurate time anywhere in the world, you won't be missing those important appointments ever again.

ONLY **$19.95** Y-1054

NOW
the world's most popular arcade game in a hand-held unit!

ALIEN INVADERS

Now you don't have to leave home to play this amazing game! This is new improved version featuring COLOURED DISPLAY plus two levels of difficulty! Great for one or two players & it doesn't 'eat' 20 cent coins! Buck Rodgers would be proud of you! Cat. Y-1152

$29.95

NEW 2 COLOUR VERSION!

NEW QUARTZ

HAM CLOCK

The fantastic Yaesu 24 hr ham clock shows you the time all over the world at a glance. Ideal for keeping those 'skeds'. Uses one 'C' cell that should last for one year. Y-1055

$51.00

WARNING!

WORLD-WIDE SHORTAGE OF ELECTRONIC GAMES

Read what a leading electronics magazine had to say:

"If you are planning to buy a video game system this Christmas for the family, be warned - the complete production world-wide has already been sold this year!" *Electronics Today International Sept. 28 1981.*

So be quick - buy now & don't be disappointed!

Texas Inst. Learning Aids

LOWEST PRICES IN TOWN!

Speak & Spell

Speech a problem? Speak & Spell helps develop skills in spelling, pronunciation & reading. Your child will learn to love spelling! cat. Y-1300

ONLY **$69.50**
SAVE $13.50!

Speak & Read

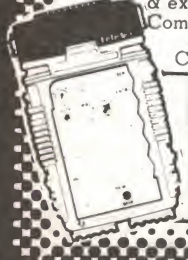
Develops vocabulary & introduces more than 250 of the most basic English words. Great for migrant English education! Cat. Y-1313

DICK'S PRICE **$89.50**
SAVE $9.50!

Speak & Math

Contains over 100,000 maths problems & explains what the problem is! Complete with 32 page instruction booklet. Cat. Y-1310

DICK'S PRICE **$79.50** SAVE $9.50!



DATAMAN

LOOK AT DICK'S PRICE!

This is an incredible learning aid for any kid who loves or hates maths! Many beaut math practice skills and games. An enjoyable way to learn. Cat. Y-1320

$22.50

AMAZING BREAKTHROUGH

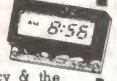
NOW A PEN & WATCH COMBINED!

Why not give something different for Xmas this year? This high quality silver pen has a built-in LCD clock in the stem. Also accepts refills. Your friends will be amazed — they'll probably want one too! Cat. Y-1030

ONLY **$9.95**

CLOCK MODULE

This clock - timer - alarm module has huge 8mm digits. Also is crystal controlled for accuracy & the claimed accuracy is within plus/minus 1.5 sec per day! Y-1050



ONLY **$19.80**

BUILD A CLOCK/THERMOMETER

(not illustrated)

CLOCK/THERMOMETER MODULE

Has huge bright red digit display, 6 display modes. Time and temperature display, alarm & control for clock, radio, etc. 12/24 hr - C/F Battery back-up facility. Y-1053. (For full design see E.A. Sept. 81).

ONLY **$34.50**

YOU CAN ENJOY THE BENEFITS OF PUSH BUTTON DIALLING!

WAS $49.50

DIGITAL DIALLER WITH MEMORY

It's the low cost way of joining the push button revolution! Converts rotary phones to push button type. Great for hobbyists etc. Memory re-dial of last number if it's engaged! Cat. Y-1175

NOW ONLY* **$39.50**

DICK SMITH MAKES YOUR CHRISTMAS DOLLAR GO FURTHER!

SONIC INVADERS

If you think this looks like something out of Star Wars, you're probably right! Each time you switch it on it plays the famous Star Wars tune! has multi coloured display with realistic explosion & sound effects! Darth Vader had better flee from this galaxy fast!

Cat. Y-1153

ONLY $49.00

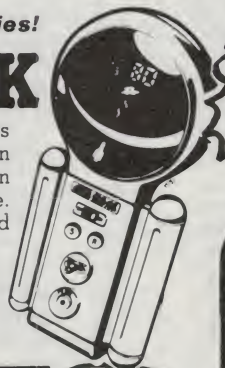
Jumpin' Galaxies!

SPACE JACK

You've seen those Space Invaders games, well here's a new one! It even LOOKS like a spaceship! Shoot down enemy ships for the highest score. Great sound effects. Dr. Spock would raise his ears over this one!

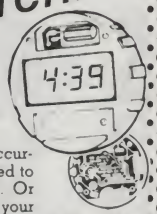
Y-1151

ONLY $49.00



BUILD YOUR OWN WATCH!

LCD WATCH MODULE



Quartz controlled for accuracy, this unit can be used to make your own watch. Or even set it in the dash of your car! See what you can come up with. Y-1039

$12.90

Enhance your decor with this

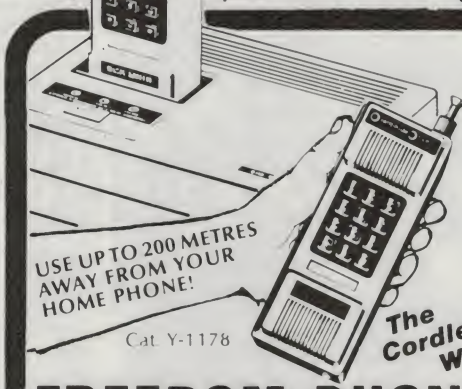
CUTIE PHONE

It has to be THE phone for you! When not being held, it sits folded. As you pick it up to answer a call, the mouthpiece flips open! Ultra modern push button dialling plus last number redial. A truly dynamic phone with a touch of Hollywood!

cat. Y-1179

ONLY $72.00*

* Current Telecom regulations do not permit the use of the Cordless Phone, Push Button Dialer & Cutie Phone in the Australian system.



USE UP TO 200 METRES AWAY FROM YOUR HOME PHONE!

Cat. Y-1178

The Cordless Way

FREEDOM PHONE

21st Century technology is all around, yet you still use a phone that's hardly changed since Alexander Graham Bell. Now you can have complete freedom from trailing wires! Features modern push button technology, memory re-dial, rechargeable handheld unit PLUS MUCH MORE! Great for businessmen, hospitals, disabled people etc.

½ THE COST OF OTHERS!

ONLY $199.00*

12 Level Computer Chess with chessmen & power supply!

DON'T PAY OVER $1,000!

$249

Become a chess Grandmaster with this amazing unit! 12 graduated levels of learning to increase your skills and it even plays against itself! Features a unique illegal move check, an audio timer PLUS MUCH MORE! Incredible value.

Cat. Y-1256

GREAT SAVINGS ON THE CRAIG LANGUAGE TRANSLATOR

Cat Y-1340

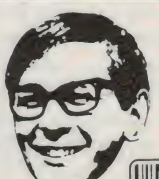
We've made a huge scoop purchase of these units at way below the manufacturers cost! Translates any language into English or the reverse! Great for overseas travellers, students, politicians etc.

~~$250.00~~ ~~$69.00~~ NOW $59.50

Great range of modules available:
JAPANESE (Y-1342) $14.50
GERMAN (Y-1343) $16.50
ITALIAN (Y-1344) $14.50
SPANISH (Y-1348) $16.50
Bar & Wine Guide: (Y-1345) $10
Calorie Counter: (Y-1346) $9.50
Phonetics: (Y-1347) $9.50

BUY 3 & GET BAR WINE OR CALORIE COUNTER FREE!!!

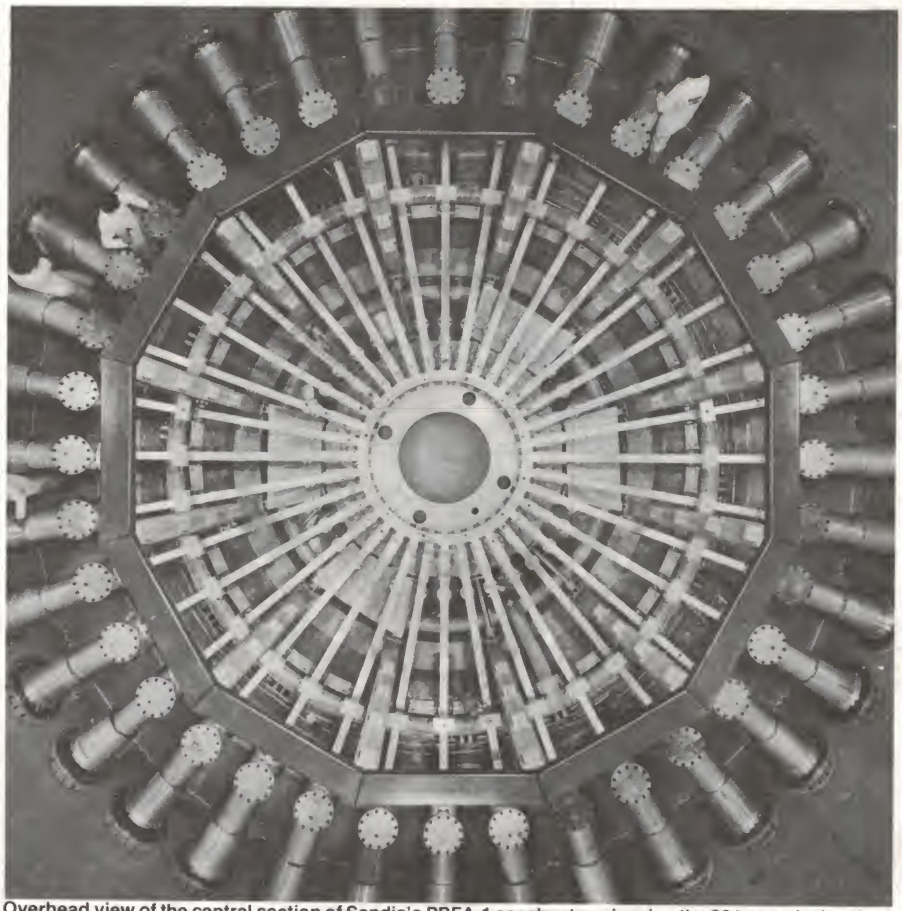
DICK SMITH ELECTRONICS



See our other advertisements in this publication for a full list of store addresses, phone numbers and postal details.

DSE 090RB

CREDIT TERMS AVAILABLE TO APPROVED APPLICANTS



Overhead view of the central section of Sandia's PBFA-1 accelerator, showing the 36 transmission lines converging on the diode area (diode not installed). This machine is now being tested in preparation for inertial confinement fusion experiments with ion beam pulses producing 30 trillion watts in 40 nanoseconds.

30 ns. It will be suitable for generating either electron or ion beams and will be used for weapon testing as well as for controlled thermonuclear research.

In 1983 to 1984 it is planned to upgrade the PBFA-1 to a more powerful PBFA-2. The upgrading will involve doubling the number of ion beams from 36 to 72 and operating from 4 MV instead of 2 MV. Each of the 72 modules of the upgraded machine will produce about 300 kA at 4 MV, so that the total power output will be about 100 TW ($= 10^{14}$ W). It should be ready for testing by 1985.

It is confidently expected by Sandia workers that the PBFA-2 will release as much energy from the fuel pellets as is required by the accelerator and that a net energy gain will be achieved soon after the testing of the upgraded machine. In a complete reactor system, the heat released would be used to power a turbogenerator.

It is intended that the fuel pellets will be injected into the reaction chamber at a rate of the order of ten pellets per second. They will be vapourised in miniature explosions which each release about as much energy as 3 kg of TNT. However, the PBFA is only an experimental reactor which will irradiate single pellets. Nevertheless, it has been predicted that if the experiments are successful, they could lead to the construction of experimental power reactors which could be in operation within 20 years of the pellet ignition principles being established.

Which beam?

Which type of beam should one use for delivering intense pulses of energy to the fuel pellets? Laser beams, electron beams or ion beams? Scientists at Sandia Laboratories are strongly in favour of ion beams, but there are some important differences between the various methods.

The transport of the beam from its source to the target pellet is a vital consideration in inertial confinement systems. A distance of at least 1 m is required between the pellet and the reactor walls to absorb the energy of the microexplosions from each pellet. Laser beams must travel in nearly a complete vacuum to prevent gas breakdown at the very high intensities used, but particle beams can be transported at a gas pressure of 0.1 to 1 atmosphere. The gas present will moderate the intense pulses of X ray and debris energy from the fusion pellets and considerably eases the design of the reaction vessel, since without the moderating effect of the gas, the intense bursts of radiation would damage the surfaces of the reactor wall.

Nevertheless laser work is being intensively carried out. The Shiva laser system at the Lawrence Livermore Laboratory equals the PBFA power of 30 TW and its updated version, Nova, has an output power of 120 to 300 TW. However, it is expected that the PBFA-2 will be constructed at a total cost of some $40 million as against the $188 million Nova laser system. Laser systems are said to be very inefficient in power (1% to 5%) when compared with the PBFA system (about 25%).

The Shiva laser system is used to irradiate targets consisting of hollow glass spheres of 322 μm diameter and with walls 2 μm thick. A mixture of deuterium and tritium gas (the nuclear fuel) is contained in the spheres. Twenty laser beams irradiate the spheres with 90 ps pulses, which deliver about 2 kJ. Thus the laser pulses are shorter in duration than the PBFA pulses and deliver less energy to the pellet.

When electron beams are compared with ion beams for inertial confinement fusion work, one of the main differences is the long range of electrons in matter. Electron beam interactions with the matter of the pellets must therefore be increased by the use of intense magnetic fields. The shorter range of an ion beam in matter is said to make it much more suitable for igniting thermonuclear fuel pellets, since the energy of the beam is more effectively deposited in a small mass of material on the outside of the pellet without the use of any magnetic field to enhance the beam interaction with the pellet.

A further advantage of the use of ion beams is that the X ray emission as the ions slow down in the pellet is much smaller than in the case of electron beams. The intense X rays present when electron beams are used can heat the pellet walls and severely degrade the quality of the compression required to ignite the fuel. In ion beam systems the designer can select the optimum pellet materials and ion beam properties to maximise the use of the beam energy in obtaining pellet ignition. Efficient methods for producing intense ion beams had not become well developed until the early 1970s, but rapid progress was then made. The same type of facilities are required for the generation of both pulsed ion beams and pulsed electron beams, so the PBFA accelerator can be used to produce beams of either type.

The PBFA equipment will use light ions such as carbon, oxygen, etc. which

can be accelerated much more readily than heavy ions. Ions have the further advantage that they can be bunched together at the target by increasing the accelerating voltage during the pulse so that the slower moving ions at the start of the pulse are overtaken by the faster moving ions later in the pulse. This can increase the pulse power by a factor of about five times. Calculations indicate that the use of ion beams is about three to ten times as effective as the use of electron beams of equal power. In the PBFA experiments the ion beams are used to irradiate gold or plastic shells a few mm in diameter with walls 0.02 to 0.4 mm in thickness.

Three fields

The work on ion fusion can be divided into three main fields. These are: (1) the ion source and accelerator; (ii) the fuel pellets and the physics of the pellet reactions; (iii) the reactor system itself.

1. Ion source

The ion source is essentially a high voltage pulse generator, which converts electrical energy into the energy of the particle beams, together with the system for transporting the ion beams to the target. The pulse generator consists of capacitors which are charged in parallel from fairly low voltage supplies and which are discharged in series to produce a high voltage for about 1 μs. The pulse passes to an intermediate storage capacitor using water as the dielectric. A triggered gas switch switches the stored energy into the pulse forming section and is the main time synchronising element for the 36 beam lines of PBFA-1. The pulse is then shortened by a beam forming section to some 50 ns duration.

The pulse energy passes from the water-filled pulse lines into a vacuum transmission line which carries it some six metres to the particle beam source. In the latter, a high electric stress across the electrodes in a vacuum results in a layer of plasma forming on the negative electrode surface within a few ns. In electron beam sources, electrons from the plasma are drawn to the positive electrode (Figure 2), whereas in an ion source a magnetic field is applied which causes the electrons to travel in spiral paths so that they can no longer

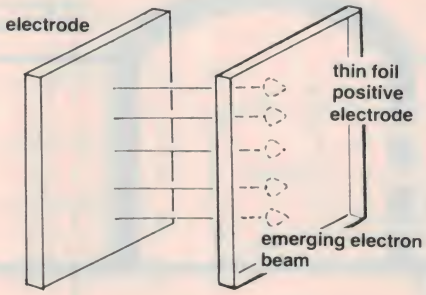


Figure 2. **An electron beam source.**

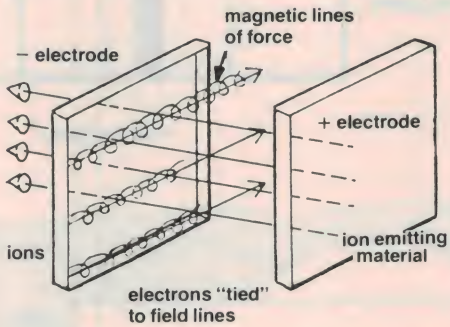


Figure 3. **An ion beam source. A magnetic field removes the electrons.**

cross the gap to the positive electrode (Figure 3). If positive ions are introduced from a plasma layer in the vicinity of the positive electrode, the electric field from negative electrons will accelerate the intense ion currents. The heavy ions can cross the gap between the electrodes almost undeflected by the magnetic field.

A channel may be formed by passing an intense electric discharge through gas; the discharge path may be initiated by a laser beam of moderate power (Figure 4). The ion particle beam is injected into one end of the channel when the channel current has reached about 50 kA and when the hot plasma channel has expanded to a diameter of 5 to 10 mm. The repulsive space charge effects in the ion beam are neutralised by the hot conducting plasma in the channel. The beam particles are confined by the presence of the magnetic field established by the channel forming discharge.

2. The pellet

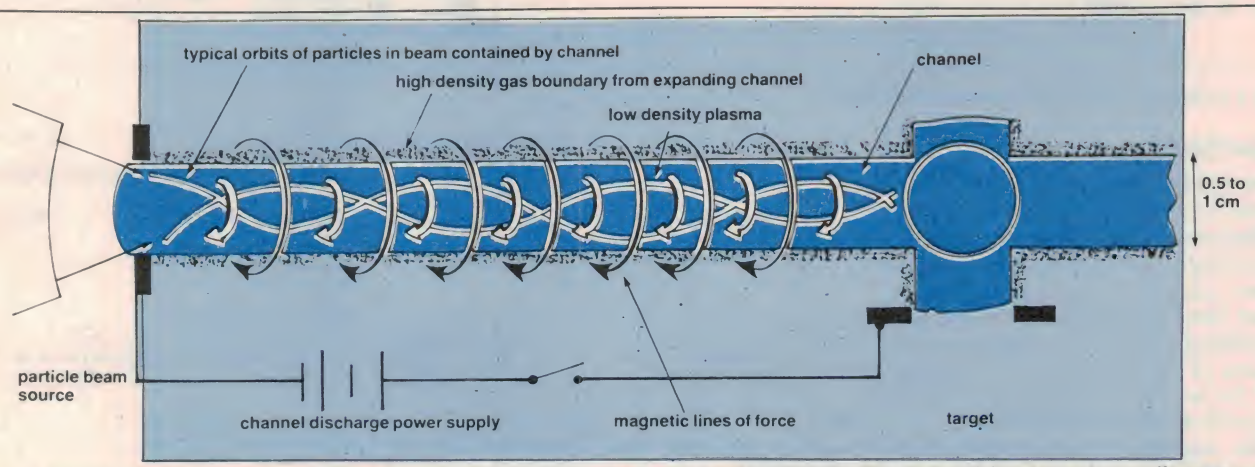
The thermonuclear fuel pellets must be designed so that the fuel is compressed very uniformly. A flash X-ray diagnostic system has been developed to examine the inside of imploding spherical pellets for symmetry of implosion; effective exposure times of 3 ns have been used. High speed holography has also been used for examining the cylindrical implosions.

3. Reactor systems

The basic reactions for beam fusion systems are:

$$^{2}_{1}H + ^{3}_{1}H = ^{1}_{0}n + ^{4}_{2}He + \text{energy} \quad (1)$$

$$^{1}_{0}n + ^{6}_{3}Li = ^{3}_{1}H + ^{4}_{2}He + \text{energy} \quad (2)$$



Step 1. Lightning bolt is originated, and current flowing in bolt heats gas, turning it into a conductor (plasma) which rapidly expands. The flowing current creates a magnetic field in the channel.

Step 2. After the hot plasma channel expands to a diameter of 0.5 to 1.0 centimetre and the channel current reaches levels of about 50 000 amperes, the particle beam is injected into one end.

Step 3. Repulsive space charge effects as well as current flow of the injected beam are neutralised by the hot conducting plasma in the channel. The magnetic field previously established by the channel-forming discharge confines the beam particles as they travel from the source to the target.

Figure 4. **An ion channel formed by a moderate power laser beam.**

The first reaction between the hydrogen isotopes deuterium and tritium produces a neutron and an alpha particle. In a practical reactor the neutrons emerging from the fuel pellet would be trapped by surrounding the pellet with a blanket of lithium where the second reaction would occur, producing tritium required for making more fuel pellets.

The heat produced by both reactions and by the X-ray and particle energy absorbed by the walls of the reaction chamber is available for the production of steam for electricity generation. Although it is not expected that a particle beam fusion reactor will be constructed for a considerable time, work on possible designs is proceeding so that this type of reactor can become a reality at the earliest possible date.

Studies of fusion reactor systems have shown that such reactors, which produce only a few hundred megawatts of electricity, may well be economically feasible. Larger plants could be constructed later. (For comparison, typical conventional generating stations range up to about 1000 MW.) The probable form and external appearance of a laser beam fusion power station of the future able to produce about 100 MW of electrical power is shown in Figure 5.

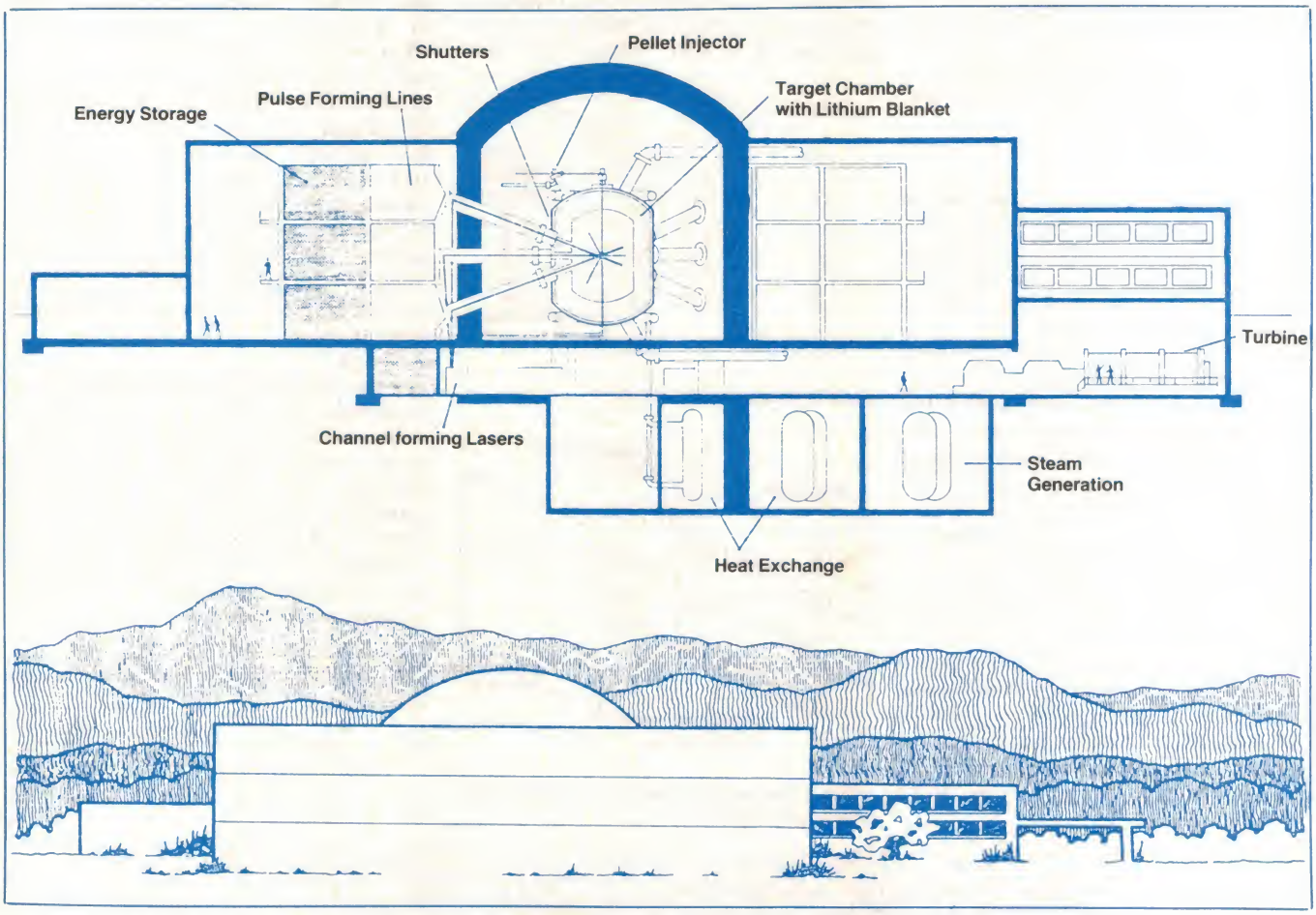


Figure 5. **A compact 100 MW power station of the future.**

Conclusions

Particle beam fusion offers a potentially attractive alternative to magnetic bottle technology for the development of controlled thermonuclear power reactors. However, even if the particle beam fusion principle is shown to be satisfactory, much depends on the economics of the reactor as to whether it will be a viable proposition. Projected timing is shown in Figure 6.

The apparatus required for particle beam fusion needs much heavy engineering work and is therefore very expensive. However, once such a reactor is set up and is properly operating, fuel costs will be extremely low. Deuterium is readily available from sea water at a cost which is currently less than US$1

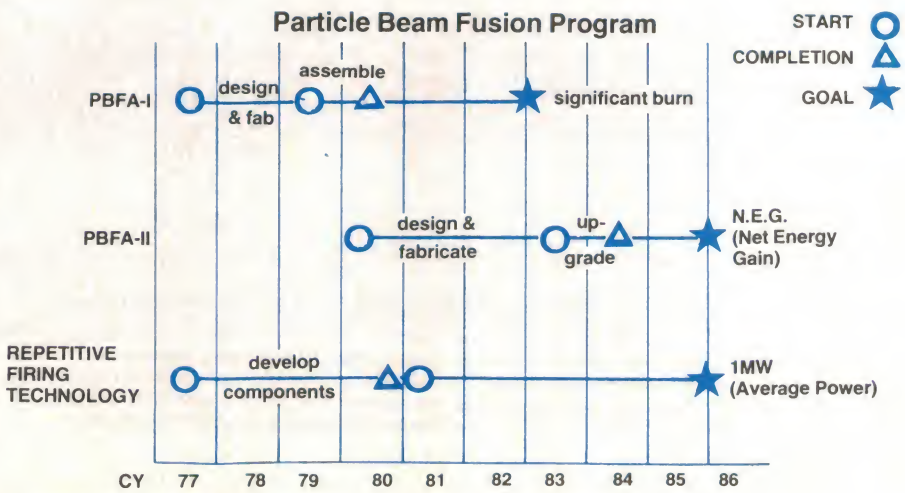


Figure 6. **Project timing for particle beam fusion work in the next five years.**

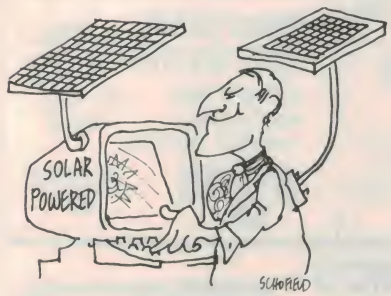
per gram. All the tritium required as fuel can be produced in the lithium blanket surrounding a beam fusion reactor, so there should be no great problem in obtaining this relatively expensive material. Indeed, it has been suggested that the pellet used in a particle beam fusion reactor should be surrounded with a blanket of natural uranium which would absorb neutrons and produce the enriched fuel required for conventional fission reactors. One of these fusion-fission reactors would produce enough enriched fuel for many conventional reactors. Ample supplies of lithium for the lithium blankets are available.

A fusion reactor must contain about 5×10^{18} individual nuclear reactions for each kilowatt-hour of electricity produced. Viewed in another way this means that the fusion of the small amount of deuterium contained in 1 gallon of ordinary water will produce a similar amount of energy to that obtained by burning about 350 gallons of petroleum spirit.

Fusion reactors (unlike conventional fission reactors) will produce only relatively small quantities of short-lived radioactive waste products, which are expected to impose no great disposal problems. Indeed, the operation of fusion reactors is expected to produce fewer environmental hazards than the burning of fossil fuels (coal, petrol and natural gas), which produces large amounts of carbon dioxide; the latter absorbs infra-red radiation and affects our climate.

Nevertheless it will certainly be a very considerable time before we have many fusion power stations in operation which provide us with a relatively cheap source of power from the deuterium contained in the sea.

The writer is indebted to Karen Shane, Sandia National Laboratories, Albuquerque, New Mexico 87185, for providing information and photographs for use in this article. ●



BANKCARD JETSERVICE-DELIVERY

Incredible Express Delivery

Phone order on Altronics Bankcard Jetservice to 8pm (Est) and we deliver next day

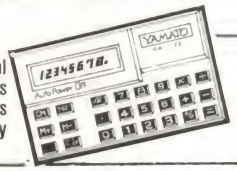
* Morning delivery all Capital Cities and suburbs * Afternoon delivery country centres * Low phone rates after 6pm * Limit 3.3kgs. * $4.00 total delivery charge * Altronics direct import prices save you a bundle **AND DON'T FORGET ALTRONICS MAIL ORDER** * Guaranteed despatch day of receipt * One low $2.00 P+P charge regardless of order size to anywhere in Australia

BANKCARD JETSERVICE-DELIVERY NEXT DAY

AT LAST THE FABULOUS ETI 5000 STEREO PRE AMP
(Brilliantly designed by Australia's top audio engineer David Tilbrook)

EXCLUSIVE metal film 1% resistors supplied throughout.
EXCLUSIVE lorin low noise high reliaity switches supplied.
Kit includes absolutely all components and full instructions and includes superb instrument rack cabinet.
COMPLETE KIT ONLY $245.00 — SEE ETI OCT 81

CREDIT CARD CALCULATOR



Extra thin, quality altronics import. Ideal for student, business man and overseas traveller for those currency conversions etc - and at our price who needs "Duty Free?" Slips neatly into the wallet.

Includes Wallet!

$9.95

VOESA LCD CALCULATOR LC-5

USES 2 STANDARD PENLIGHT BATTERIES *High visibility display *2 years operation Plus on two 25c batteries *Altronics Direct Import NOTE - Definetly the most easy to use calculator I have ever had - Jack O'Donnell M.D. Altronics

$12.50 Exc. Batteries

UNIVERSAL LED DIGITAL CLOCK WITH ALARM

Model ACI12/2 *Mains Powered *Attractive Wood Grain Cabinet *Mini Size 50W x 75D x 50H IDEAL XMAS GIFT

ONLY **$19.50**

DIODE SUPER BUYS

IN914	5c	100 up	3c
IN4002	6c		5c
IN4004	8c		6c
IN4007	10c		8c
IN5404	30c		25c
IN5408	40c		32c

DALO PENS

SAVE 40%

Great PC art- work aid. **$1.50**

"PRINTING CALCULATOR VOESA 1871 P.D.

This portable ,Or mains powered adding ,machine ,and calculator has in-built rechargeable batteries with modern silicon chip technology — for home or business

$65

OEM PRIME SPEC LEDS

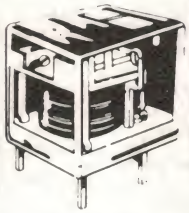
DIRECT IMPORT PRICE

3mm	Red	15c	10 up	13c
	Green	20c		15c
	Yellow	25c		20c
5mm	Red	10c		8c
	Green	25c		20c
	Yellow	30c		25c
	Orange	30c		25c
RECT	Red	.25c		.20c
	Green	.30c		.25c

MINI RELAY

1000's Sold PCB Mount 8-15V Coil

2 Models



S4060 SPDT **$1.50**

S4061 DPDT **$2.00**

DIMENSIONS 14H x 20W x 12D

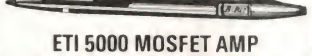
HARD TO GET SEMIS AT BARGAIN PRICES

2N6027 PUT	65c	MPF105	50c	BF470	$1.00	UAA 170	$3.80
BF115	75c	LM380	$1.60	VN88AF VMOS	$3.95	2N3055	85c
MPF102	55c	CA3140	$1.25	MEL12 PHOTO DARLINGTON	95c	BUX80	7.95
HF/VHFFET		BF469	$1.00	LAM3915 LED BAR/DOT DRVR	$3.50	BU208	4.20
MPF104	50c					LM317K	2.95
						LM309K	3.50
						TA7205	2.95
						MPF105	50c
						LM339	1.75

PEN WATCH

Superbly styled S. Steel, fantastic Xmas bargain, a real quality ball point pen - uses readily available Parker replacement refill. Inbuilt watch shows day, date and seconds. Includes instructions and gift Box.

$9.95



INFRA RED LED SAVE 60%

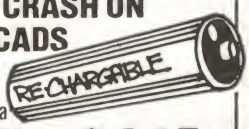
Philips COY89A

1-24	25-99	100 up
75c	65c	55c

INGERSOLL AM/FM PORTABLE RADIO $24

Battery or Mains Powered, Revolving Telescopic Aerial Incredibly sensitive receiver - great for camping, the beach and around the house DIMENSIONS 210W x 130H x 50D

PRICE CRASH ON AA NICADS



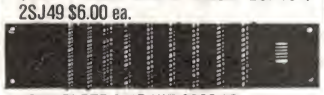
Quality Matsushita manufacture 1.2v 500mah

FROM **$1.15**

1-9	10-99	100+
$1.50	$1.30	$1.15

ETI 5000 MOSFET AMP MOSFET BARGAINS

*Audio Power module kit $59.95 (1 channel) *Power transformer $37.50 with copper flux strap *Electro's 8000 MF/75V $9.50 *Mosfet semi's hitachi 2SK134, 2SJ49 $6.00 ea.



*COMPLETE AMP KIT $289.00
Includes superb finish front panel/heat-sink and every last nut and bold, even solder! FULL INSTRUCTIONS INC.

NEW OP AMPS

Used in the 5000 series preamp

NE5534N	$1.25	10 up $1.15
NE5534AN	$1.95	$1.85

NICAD CHARGER

GREAT VALUE

Charges 4 aa nicads VALUE **$7.50**

240V Mains Powered

RANK-GE CASSETTE RECORDER

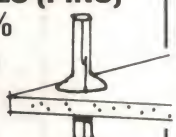
ALTA MODEL A805 *Built in Hi Quality Condenser Mic for superb recording *External microphone and remote on/off Jack *Earphone Jack & Auxiliary input Jack *Mains or battery powered (4xAA) Guaranteed by Rank-GE

VALUE PLUS **$39.50**

PC STAKES (PINS) SAVE 33%

Pack 100 (ave)

$2.00 only



Bitsav RESIN CORE SOLDER

$1.00 OFF 200g reel Lab grade 1mm diam BARGAIN

$3.95 **$3.50**

ALTRONICS
105 Stirling St. PERTH
(09) 328 1599
for instant service

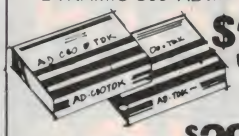
All MAIL ORDERS:
BOX 8280 PERTH
Stirling St. WA 6000

Rush in your order NOW, we will rush it back

BANKCARD JETSERVICE-DELIVERY NEXT DAY BANKCARD JETSERVICE-

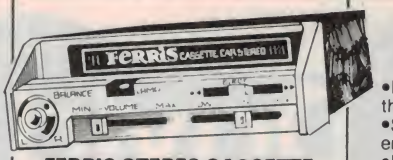
INCREDIBLE BARGAIN
FAIRCHILD LED DISPLAY
FND 500 .5IN
WERE ~~$2.95~~
95¢ ea.
85¢ 10 up

TDK TDK TDK TDK TDK
BARGAIN OF 1981 - ACOUSTIC DYNAMIC C90 ADC90



$3.50 ea.
6 PACK **$20.00**

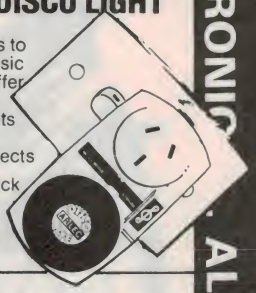
FERRIS STEREO CASSETTE



JM8001. Top quality unit price slashed to clear. 6 Watts per channel, fast r/wind, f/fwd, auto eject.
AMAZING LOW **69.95**

ARLEC DISCO LIGHT
- Flashes lights to the beat of Music
- Strobes at different speeds.
- Dims the lights for dancing, moods and affects

30 only - Be Quick
$30



LIGHT DEPENDENT RESISTOR
Dark 200K Light 330 OHMS

60¢
10 up **55¢**

CMOS 4011B

Quad. 2 Input Nand Gate
20¢

PRO GRADE TINNED HOOK UP WIRE
13/.12MM 100M rolls - 8 colours, Black/Red/Brown /Yellow/Green/ Blue/White/ Orange.

$4.95 per roll
or 8 rolls for **$35.00**

WESTON 2.5 WATT MARINE HANDHELD
CHANNEL 27.880 fitted Includes carry case - get one for the boat today
$59.95

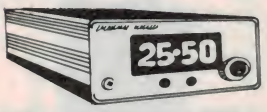
TRF RADIO I.C. ZN414
Equiv. to 10 Transistor Radio with Just 7 External components (Inc. Battery - 1.5V 3MA) Freg. Range 150 KHZ-3MHZ DIRECT HIGH Z EARPHONE O/P DRIVE
LESS THAN ½ PRICE
$1.50

Write for free circuit diagram

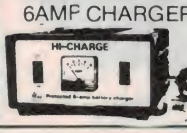
AM/AIR BAND RADIO
Listen to Jumbo Jet Pilots AM BAND + MHZ 108 - 174

GREAT VALUE **$24.50**

EA AND ETI KITS (Nov. Only) SAVE 40%
- DIGITAL CAPACITENCE METER EA 80 Measures 1PF - 99.99 MFD ~~$59.95~~ **$40.00**
- LED AND LADDERS EA 80 Great fun for the Kids ~~$17.95~~ **$12.00**
- MUSICOLOUR IV EA 81 Light Chaser and 4 Chan. Musicolour ~~$89.95~~ **$79.50**
- DIGITAL ENGINE ANALYSER EA 80 ~~$59.95~~ **$45.00**
- METAL DETECTOR ETI 561 Includes coil (less former) ~~$29.50~~ **$22.00**



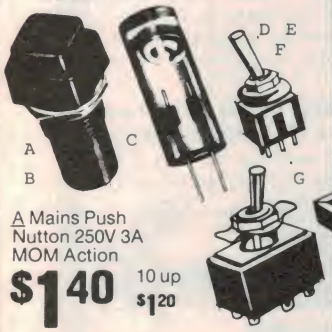
- HI CHARGE CAR BATTERY 6AMP CHARGER Arlec Project ~~$57.95~~ **$45.00**



LUMEN SOLAR POWER ELECTRONIC KIT
25 EXCITING PROJECTS IN ALL
*No soldering required *Safe, Educational, Fun PROJECTS INCLUDE - SOLAR POWERED - *Transistor Radios (3 Circuits) *NOR/NAND Computer Circuits *OR/AND Computer Circuits *Electronic Buzzer -Amplifier *Morse Code Communicator *Morse Code Oscillator
BATTERY POWERED —
*Transistor Radio Circuit *Capacitive Discharge Circuit *Burglar Alarm *Bird/Cat Sound Music Alarm (varied by Light)
$19.50

SUPERB QUALITY WESTON SLIMLINE GRAPHIC EQUALISER/AMPLIFIER
Incredibly compact 22H x 145W x 132D 7 Key 25W/25W Led Level meters/Qual Japan Manf. Freq. Response 20HZ - 30 KHZ.
$75.00

SWITCHES
DIRECT IMPORT PRICES



A Mains Push Nutton 250V 3A MOM Action
$1.40 10 up $1.20

B Ditto Push on - Push Off
$1.50 10 up $1.30

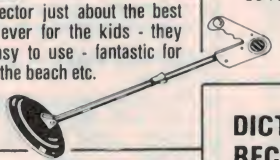
C Mercury Tilt SW 120V 1 AMP
$1.25

D MIN toggle 250V 3A SPDT
10 up - **95c**
$1.00

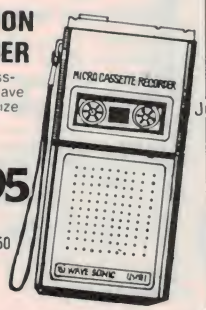
E MIN toggle 250V 3A DPDT
10 up $1.80
$1.40

F MIN toggle 250V 3A DPDT Centre
10 up $1.30
$1.95

BFO Metal Detector just about the best Xmas present ever for the kids - they really work. Easy to use - fantastic for prospecting, at the beach etc.
$19.95



DICTATION RECORDER
Every businessman should have one Pocket size with quality Japanese mechanism
$39.95
Microcassettes $3.50



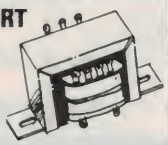
SHEEN CAR FRIDGE
(Reverse cycle - Heats or Cools at the flick of a switch)
Just about the greatest little accessory for your car this summer
Holds 17 cans (over two gallons)
$79.50

PHONE DIALER PUSH BUTTON

$35.00
Fits in minutes to any telecom style phone

PUSH BUTTON SWITCHES
Ideal PCB mount - Momentery 2 pole Push-on Positive "click action" Geat for alarm equip. intercoms, custom keyboards etc.
PACK OF 4
$2.25
$1.85
10 Packs or more

2851 TRANSFORMER
DIRECT IMPORT
$2.50
10 up **$2.25**



INCREDIBLE AM/FM CAR STEREO OFFER!
69.95
Includes speakers

FERRIS TWIN CONE SPEAKERS
10 Watts max. Complete with grills.
Inbuilt Power Amp 7 Watts RMS Per Channel

David Reid Electronics

WALKMANS

AM/FM STEREO CASSETTE
ARE YOU WIRED FOR SOUND

Playmate stereo cassette player with record facility and fast forward & rewind at justaLOW...
$63.95

TOP QUALITY
Weston Stereo Headphone Receiver

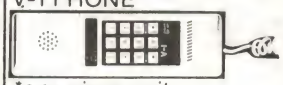
Prosonic FM/AM Stereo Radio with its own stereo headphones
ONLY $39.95
Walk-A-Long Headphone Radio just **$18.95**

★★★

Why dial in a push button age with the Push button phone dialer, fits into conventional telephones;

only **$29.95**

Why not replace that old phone completely with the V-1 PHONE*



*one piece unit
*push button keyboard
*memory redial
*mute button
*tone ringer control
at an unbelievable
$49.95 *not licenced yet by Telecom

Features
**FM/Stereo lamp*
**2 headphone jacks*
**FM/FM stereo selector*
**2 volume controls*
**belt clip*
$69.95

FREE GIFT CHRISTMAS SPECIAL
Electronic wrist or pen watch for purchases over $100.
**Limited to one per customer purchase*

DAVID REID ELECTRONICS PTY. LTD.
SYDNEY:
127 York Street
Sydney 2000 N.S.W
P.O Box Q103
Sydney 2000 N.S.W.
Phone: (02) 29 6601

Enclose your personal cheque. Money Order or Bankcard Numbers as specified below.
Check and fill in
☐ Cheque or Money Order Enclosed
☐ Charge to my Bankcard No.
CARD HOLDER'S NUMBER
496
Signature
Card Expiry Date

Part No.	Description	Quantity	Price	Total

Please print clearly. Date _____ Minimum Postage Packing charge 1.00
Tel _____ Plus Postage Packing surcharge
Name _____ Subtotal
Address _____
_____ Postcode _____ TOTAL

now better than ever. sinclair ZX81 Personal computer

Complete with mains adaptor, leads & basic manual

New, improved specification

- Z80 a microprocessor — new faster version of the famous Z80 chip,
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing.
- Graph drawing and animated display facilities.

Coming soon — the ZX Printer
Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM),

Ready assembled ZX81 Sinclair Personal Computer incl. mains adaptor, leads, Basic manual $250
16K-BYTE RAM pack $150
8K-ROM $75
ZX Printer (to be announced)

Yes we are also stockist of the ATARI 400 PERSONAL COMPUTER SYSTEM

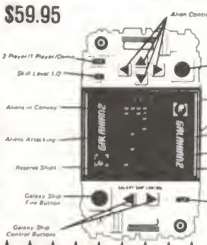
YOUR COST ONLY $699.00

The 400 is supplied with 8K bytes of RAM, and offer a 10K ROM Operating System and an 8K ATARI BASIC Language Cartridge.
The 400 features 4 independently programmable sound synthesizers and a built-in speaker.

Talking about ATARI we stock And sell a full range of Cassettes for the T.V. Game Computer System.

System Priced only	**$265.00**
Cartridges @	$39.95
Sells elsewhere	$49.95
RRP $314.00	$59.95

The latest in kids entertainment, fight the Aliens with: GALAXIAN 2|Three colour electronic computer game.
$59.95



Bill Edge's ELECTRONIC AGENCIES

115-117 Parramatta Road Concord 2137
(Corner Parramatta Road & Lloyd George Ave)
Telephone: (02) 745 3077 (2 lines)

Mail Orders:
PO Box 185
Concord
2137

TRADING HOURS
Mon-Fri 9am-5:30pm
Saturday 9am-noon
Sunday 10am-2pm

MAIL CHARGES
$5-$9.99 ..... $1.00
$10-$24.99 ..... $2.00
$25-$49.99 ..... $3.00
$50-$99.99 ..... $4.00
$100 or more $5.00
All heavy or bulky items (over 20kg) sent Comet Road Freight $8.00 anywhere in Australia.

what else do we carry? HI-FI ★ KITS ★ TEST EQUIPMENT ★ SEMICONDUCTORS ★ COMPONENTS

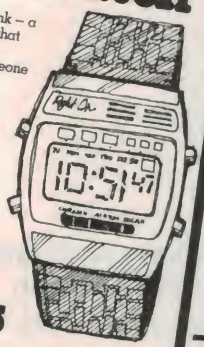
All prices correct and goods in stock at time of going to press. Please phone to check current availablity.

SAVE, SAVE, SAVE, SAVE ON CHRISTMAS SHOPPING

NEW Why pay $35? Digital Watch

No, not a piece of junk – a quality digital watch that would make an ideal Christmas gift for someone you know. Features:

- ★ Alarm
- ★ Solar power
- ★ Day, date & month
- ★ Stop watch with lap timer
- ★ 6 month guarantee



Look at our price

$22.95

PROTECT YOUR FLUKE METER FOR ONLY

A top quality instrument like your Fluke digital multimeter deserves the protection of this top quality, custom made case. Ideal for field service use – keeps your Fluke looking and working like new.

Cat. QE5226 **$18.95**

4 way mini DIP Switch

Top quality switch ideal for computer or other 'set & forget' applications.
Cat. SE0709 **$2.00**

19" RACK CABINET

Anodized black aluminium. Look at this price! HE1477

$39.95

OR BUILD YOURSELF THESE SUPERB ETI 4000/1 SPEAKERS

The ultimate build-it-yourself hi-fi speakers. This is the ultimate performance design by ETI based on the Philips range of high quality drivers. Acoustic suspension design with 4 drivers – each operating only in its optimum frequency range. This gives minimum distortion, maximum fidelity sound – and at a price that's half that of most commercial speakers of this quality. Kit is sold in two parts: the component kit which contains all drivers, crossover components and wiring; and the cabinet which is supplied fully assembled – all you need to do is mount the drivers and wire it up.

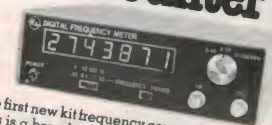
4000/1 Speaker kit Cat. CE2430 **$499**

4000/1 Cabinet Cat. CE2470 pair **$250**

NEW 25 Pin D type Socket

A top quality computer connector ideal for use in RS232 and other interfaces.
Cat. PE1786 **$7.95**

NEW EA Freq Counter kit



The first new kit frequency counter for a long time. This is a brand new design from EA (see Dec 81) housed in a professional style Pactec enclosure – making it extremely attractive and usable.

- ★ Measures up to 50MHz (optionally 500MHz)
- ★ 7 digit display
- ★ Variable period and gating times
- ★ Period measurement capability
- ★ Leading zero suppression

And the Electronic Agencies kit is absolutely complete – don't buy kits with parts that aren't as specified by Electronics Australia.
Cat. KE1810

ONLY **$119**

Cat. KE1815 (kit to convert to 500MHz) $25.00

ETI Low ohms meter

Accurately measures very low resistances – measures critical cable resistances and emitter resistors etc that a multimeter couldn't cope with.
ETI158 Nov. Cat. KE1877 **$29.50**

EA Sand glass

The solid state egg timer to end all! Intriguing 'hourglass' design has the character of the traditional timer – with the accuracy of electronics.
See EA Nov. Cat. KE1027 **$23.50**

EA Traffic Buzzer

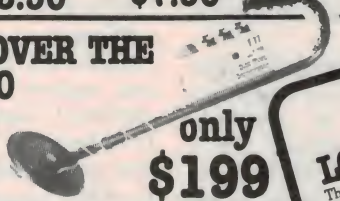
If you have trouble hearing your indicators – in open cars, bikes, over loud stereos or if it just isn't loud enough – here's the answer. Easy to build and install.
See EA Nov. Cat. KE0193 **$7.50**

NEW DC PLUGPACK
240VAC–
6,9,12V/300mA
Cat. ME7721
$9.75

FREE 1982 CATALOGUE

Just come into our store and a free copy of our 32 page catalogue is yours! If you can't get in, just send us 75¢ for pack and post and we'll have one on its way to you.

FIND A FORTUNE OVER THE HOLIDAYS! ETI1500 METAL DETECTOR



One of our most popular kits. The only kit metal detector that can compete with the expensive commercial units – and at about half the price!
Cat. KE1460 Complete kit as shown

only **$199**

NATIONAL LOGIC DATA BOOK

The full range of National Semiconductor's logic ICs. Everything you need to know to design and build logic circuits. Cat.BE4015

$12

6 HOUR MAIL ORDER TURNAROUND

Windspeed kit

EA's new solid state wind speed measurement kit. If you need to know the wind speed, you need one of these! Cat. KE1630 Complete kit as per article

only **$44.50**

ASCII keyboard kit only $41.95

60 keys individually switched contacts.
Cat. KE6605

Philips Hi-Fi Woofer

Yes, we've expanded our range of hi-fi speakers yet again! This is a top quality unit from the Philips range. Features a 300mm paper cone, rubber surround and very low distortion.

- ★ 35-1800Hz
- ★ Resonant frequency 22Hz
- ★ Magnet mass 850g
- ★ Power handling capacity 80W RMS max
- ★ Sound pressure level 89dB 1W/1m

Model number AD12200/W8 Cat. CE2126

NEW $62.50

New Foster Guitar Speakers

Model C380K60 380mm cone; 16 ohm voice coil; 180W continuous power; magnet weight 1821g; cast frame; 80mm voice coil; frequency range 40-4500Hz. Cat. CE2375 **$109**

Model K300K08 16 ohm impedance; 50W maximum power; Magnet weight 567.5g; 35mm voice coil; 300mm cone; Frequency range 60-4000Hz. Cat. CE2370 **$49.95**

A merry Xmas From Bill & Staff

NOW A Computer for $99

ETI660

Plugs into any TV

Here's the super economy computer you've all been waiting for! Complete kit including PCB, all ICs and components (pre-programmed 2716 ROM included) and IC sockets. Cat. KE6600 $99.00

Cat. KE6601 Keypad to suit includes 18 keys and Scotchcal labels for keys $32.00

Cat. KE6602 Colour option $13.50

Cat. KE6603 Video RF modulator including die-cast box. $14.50

Cat. ME7712 Plugpack to suit 8VAC/1A $11.95

Cat. HE9660 Double sided glass PCB $29.50

Cat. SE1000 Pushbutton keys only $1.90

Extra RAM option: converts to 3K RAM
4 x 2114 normally $19.80 special price $17.00 Cat. ZE6114

These two slot car controllers will put more zap in their zip

Jonathan Scott

A spare $15 and an idle Saturday afternoon led Jonathan and a few 'assistants' into the labyrinthine maze of the world of slot cars. Your basic slot car set is so basic that Jonathan thought the application of a few engineering and physics degrees, computers, components, electricity and trials would help. These two projects are the result!

WELL, let's not beat about the bush. Slot cars are fun. The genesis of this project was the purchase of a cheap set and the realisation that there was much room for improvement in the whole thing, especially the 'electronics'. Since then, we have built several controllers, purchased an alarming length of track, bought and modified too many controllers and cars, and generally had a load of fun! Here are the fruits of the labours, both in the form of electronic projects and in some discussion of what you can do to get the best performance from even a cheap set of slot cars.

Shortly after the infection set in, the author's household was to be found in a huddle with a couple of computer programmers, another engineer and a couple of PR people. A list was made of all the things that anybody could possibly want out of a given car set, and all the things that could possibly be desired in a controller. Argument ensued. The fearless editor of this magazine would argue for cost effectiveness; another for a no-holds-barred approach. Thursday nights were set aside for the various parties to meet and report ... After preliminary models of controller had been made and *thoroughly* evaluated, it was conceded that all the aims could not be realised in the one type of controller. Hence, two lines were followed and we have the ETI-824 Slot Car Power Supply and the ETI-825 Slot Car Controller. We also have a lot of tips for optimising your set itself, and we trust that these are sufficient to turn a couple or three $15 sets into a first-class slot car racing set-up.

We also present several suggested layouts, and suitable constructs and axioms for the optimisation of your own layouts.

In the course of this research use has been made of calculators, programmable calculators, desktop computers, plotters, engineering degrees, physics degrees, computer science degrees, a mound of components a lot of paper and a *hell* of a lot of electricity — so be warned that one can get pretty involved. Closet racers, prepare for exposure!

If you are not sure that you are a fanatic, the ETI-824 is probably what you require. It is relatively simple to construct, cheap, and easy to get going. It is basically a replacement for whatever you are using to power your set now. It offers operation from ac or dc, car battery, model train transformer, doorbell transformer or a range of typical project transformers or power supplies. It gives independent protected supplies for each lane, adjustable for most car set types available.

If you're after something really exciting, then the ETI-825 is *it*. This is not a project for beginners. It gives independent, protected supplies for each lane. It can operate in voltage and current modes. It has powered braking, controlled overshoot and fuel tank simulation. It has fault and fold warnings, does not load the hand controllers, and can handle a wide range of maximum torques on sets of 4.5 to 12 volt rating. If you are really enthusiastic or you have just blown $100 to $300 on a Scalextric set, this is the one for you.

Slot cars and tracks — a dissertation

In practice, the basic rheostat in series with the track (car) is not at all a bad compromise. For a given control setting the car accelerates fairly rapidly towards a final speed. This is because torque is proportional to current (in the permanent magnet motors used) and current is a maximum when the car is standing still; as the engine RPM increase so does the back emf, or rather the internal emf of the engine, which represents the mechanical power output in the mathematical model of the engine. As this rises, the voltage drop across the control resistance decreases, and so does the current, the torque and the acceleration. (Figure 1.) This gives a very car-like performance for a minimum of parts.

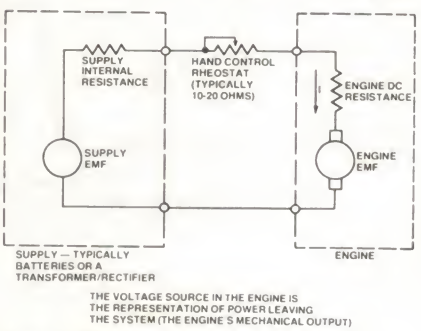


Figure 1. **Circuit model, slot car set.**

The final speed is fixed by the minimum dc path resistance, the available supply voltage and the amount of friction and other losses in the car. Overall performance includes cornering ability, which is affected by the car weighting and wheel

FUN!
FUN!
FUN!

type and condition. Attention to these factors will effectively 'tune' the car.

If you think you have a car set with one car better than the other, the chances are that checking the above things will reveal a silly fault in one car, and you will end up, after some tinkering, with two improved cars. Let us go through a typical tuning up of a small car, such as those in the $14-$15 sets. We will start at the car and end up at the controller.

Firstly, the wheels. It is important to check that these do not have some wobble or severe out-of-roundness. The tyres should be slightly rough, so that they grip, and fairly flat at the point of contact with the track, so that they do not bounce at all when the wheel rotates quickly. See that the tyre is fitted straight, if you have removable tyres, and that the wheels are squarely mounted on the axles.

Next it is worth opening the car up. Check that the axles and cogs are free of dust and carpet fluff. A very small touch of light machine oil on bearings and cogs is a good idea, though not entirely necessary. DON'T oil the tyres or any exposed bit of the car. See that the cogs mesh neatly and fairly silently. On an expensive car, such as Scalextric, these things should be in order already.

Now let's look at the brushes. These are, in our experience, the most vulnerable point in the car. Brush friction usually accounts for 90% of car performance problems. The brushes should be clean and dust free. There will be some unravelling of the braid. This is good. The ends of the brushes seem to benefit from a bit of 'combing'. This can be done with a small jeweller's screwdriver, a scriber or scalpel. About three to five millimetres of combed braid is nice. Finally, the shape of the brushes is important. There are several ways to bend the brush, and you should experiment to see which is better. We used the down-and-then-straight pattern. (See Figure 2.)

Next, the minimum rheostat resistance is important. Some controllers have such resistive leads that the series resistance never gets below an ohm or two. If you have a protected *voltage* source this is a disadvantage.

Finally, the supply potential is critical. If it is too high, the control becomes too critical and it is too hard to get just the right amount of power. It cannot be too low, of course, as you would not get anywhere near enough power to realise the maximum speed of which the car is capable without crashing — which takes out all the skill. As well, if the supply is not regulated, one car can interact with the other; the extreme of this is seen when one car suddenly 'shutting down' causes such a surge that the other spins off the track. (It can happen!)

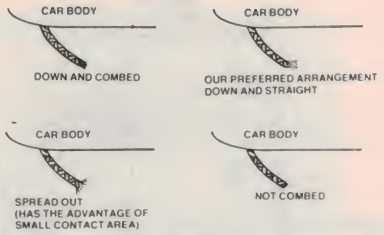
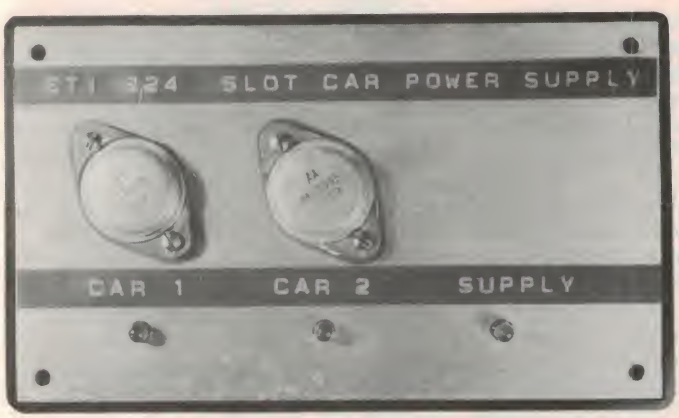


Figure 2. **Arrangements for the contact brushes.**

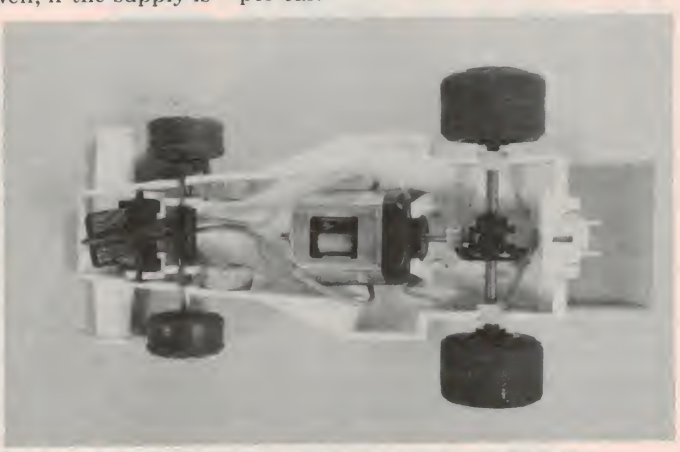
One further factor is worth discussing, with respect to the car: weighting. This is an area where you are going to have to experiment for yourselves. Most cars have spaces inside the plastic shells. Nuts or other pieces of metal can be secured in these spaces with a little Blutac, or similar poster adhesive, to add weight. Weight will reduce the acceleration for a given power, but it will increase wheel adhesion on the road. It will also change the handling, possibly making spinouts more likely, and reduce the period of time required between brush realignments. In our experience, a couple of 2 BA or similar nuts in a small car, near the middle and low down, are quite beneficial if you have adequate power, as with our controllers.

The 824 supply

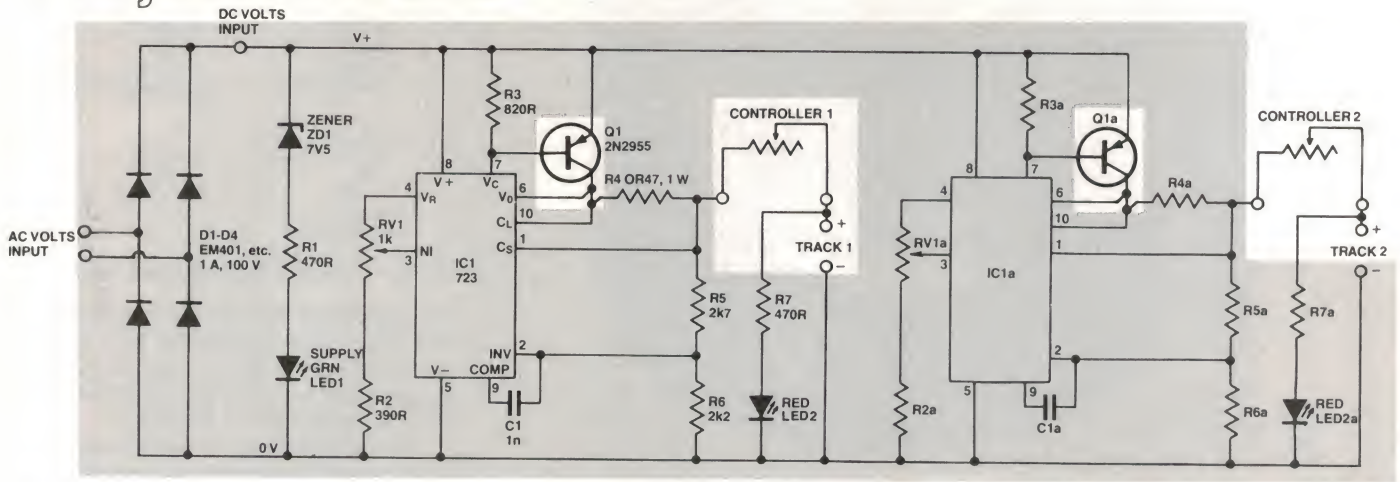
As we have said, all that is necessary to achieve quite adequate performance is a voltage supply for each car. It needs to be the right voltage, and each car should not interact via the supply with the others. The ETI-824 is this. It is versatile in that it will operate from whatever source of voltage you have available; it simply needs to deliver at least three volts more than the cars need (average) and to be able to supply the maximum current, typically ½ to 1 amp per car. ▶



Plain and simple, the ETI-824 slot car supply.



Example of how to weight a car with two nuts stuck under the body.



HOW IT WORKS — ETI 824

This is basically a crude series voltage regulator, based on the 723 variable regulator IC, that supplies power to the rheostat in the hand controller. The rheostat is in series with the motor in the car, via the track connections. The voltage supplied to the controller and car can be preset anywhere between about 3 V and about 12 V.

The circuit is designed to be powered from a variety of sources — bell transformer, car battery, plugpack, model train transformer or conventional 240 Vac to 15 V/1-2 A transformer — whatever is available. If the source is ac, such as that direct from a transformer secondary, the diode bridge rectifier formed by D1-D4 rectifies this, supplying unfiltered dc to the circuit. These four diodes may be deleted if the unit is run from a dc supply, or they may be left in, provided the dc supply you use exceeds the voltage required by the car by about four volts. Leaving D1-D4 in place has the advantage that the device can be run off ac at any time, and when running it off a dc supply it can be connected either way round as polarity doesn't matter and no possible damage can be occasioned by accidental reverse polarity connection.

To indicate that a supply of sufficient voltage is connected to the circuit, ZD1, R1 and LED1 make a simple indicator. When the supply voltage between the V+ and 0 V rails is high enough to overcome the zener voltage plus the voltage drop across LED1 and R1 at a current of a few milliamps, LED1 will light. You need to produce a minimum of about 10 V between the V+ and 0 V rails. Note that while this is sufficient for the IC regulator circuit to operate, it may not be enough for some slot car sets. For those that require 12 Vdc, at least 14 V between the V+ and 0 V rails will be required. An ac input of up to 24 Vac (RMS) may be used.

Following the rectifier and indicator sections of the circuit is the regulator, which consists of IC1, Q1 and associated components. Each lane in the slot car set should be supplied with a separate regulator circuit to ensure that one lane does not interfere with the operation of the other, especially in the event of a short circuit due to a crash or a fault, etc. Two regulator sections may be run from one rectifier section.

The 723, IC1, controls the base current of Q1 so as to deliver the required voltage to the hand controller, except when the external circuit (controller and car motor, via the track) attempts to draw current above about 1.2 A. In this case, the 723 reduces the voltage supplied to the external circuit to prevent possible damage.

The output voltage is set by RV1. By adjusting this preset control, the voltage delivered to the controller and external circuit may be varied anywhere between about 3 V and about 12 V maximum. This should be adjusted to suit the particular slot car set you are using by setting its position so as to deliver a suitable amount of acceleration to the car when the hand controller is set full on.

LED2 indicates that voltage is reaching the track. This is useful to check correct operation and for detecting shorts on the track.

The 825 controller

For superior performance, the controller can have several 'extras'. This is the ETI-825. Firstly, this gives you *fuel tank simulation*. This means that the control box has a meter which represents fuel in the car. A button 'refuels' the car, provided it is stationary. When it has petrol, you can go again. As the petrol is used up the car gets more acceleration, corresponding to the reduction in weight. The degree of the effect is presettable by a resistor (R107-R207 for the second car). It is rather exaggerated with the value given, but this is more fun. Of course, if you run out of fuel, the car slows down and finally coughs to a stop.

Next, the 825 offers *controlled overshoot*. If the output momentarily exceeds the level that your hand controller commands, the car responds more 'snappily'. This accelerates it a bit harder at first, corresponding to 'dropping the clutch', and brakes hard when it is slowing down corresponding to hard braking. You can even lock up, if you are too hasty!

The controller also informs you if it is folding, such as when the track is short-circuited. In the current mode, it warns of open circuit as well. It does not, in addition, load the hand controller rheostats, as they do not carry the car current. (In some sets the controller handsets get very warm.) It comes with an internal power supply as well. Both controllers are, of course, short-circuit protected.

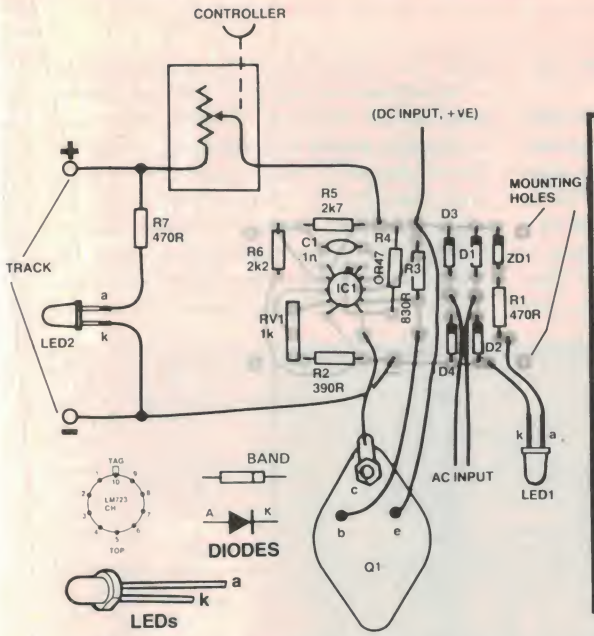
The two modes, current and voltage, each offer their own advantages. Current mode gives torque proportional to control depression, as torque is proportional to current. It has slower take-off and generally sloppier, though perhaps more realistic, operation. It is also more immune to bad contact in the track and brushes, if you are having trouble in that direction. Voltage mode, which we prefer, gives a very tight control, with snappy response from the car; perhaps less realistic, but more fun. It seems to demand more from the drivers, though performance is considerably superior. You can actually get a car to lock up and slide sideways out of a long straight into a corner, and accelerate out of the corner, the car's pin in the slot all the time, which is not a mean feat!

Having set forth the pros and cons, we will proceed into the construction of the two projects, and you may choose the one you feel is appropriate.

Construction ETI-824

Construction of the ETI-824 is relatively straightforward. You will require one pc board for each lane, though some components will not be required on all but the first board. If you have only two lanes, as is likely, you can follow our construction diagrams exactly. Further lanes will simply demand a larger box and a repeat of the wiring up of the first two boards, less ZD1, R1 and LED1.

The first step is to drill the box. We used a jiffy box, primarily because they are the cheapest form of conveniently workable container. If you want it to look particularly good, or it will have to withstand nasty knocks, a diecast aluminium or extruded type of box of sufficient size can be used, but is likely to



PARTS LIST—ETI-824

Resistors ..... all ½W, unless noted
R1, R7 ..... 470R
R2 ..... 390R
R3 ..... 820R
R4 ..... 0R47, 1W
R5 ..... 2k7
R6 ..... 2k2
RV1 ..... 1k trimpot

Capacitors
C1 ..... 1n greencap

Semiconductors
D1-D4 ..... 1N4001, EM401, etc. 1A, 100 V
ZD1 ..... 7V5, 1 W zener
LED1 ..... TIL220G, green
LED2 ..... TIL220R, red
IC1 723
Q1 ..... 2N2955

Miscellaneous
ETI-824 pc board; jiffy box to suit; terminal block; transformer (if necessary); nuts, bolts, wire etc.
NOTE: The supply circuit is duplicated for the second track. Those components duplicated are designated Q1a, R4a, IC1a, C1a etc.

Price estimate

We estimate the cost of purchasing all the components for this project will be in the range:

$15—$18

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project, such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel supplied (if used) etc — whether bought as separate components or made up as a kit.

add 20-50% to the cost. Anyway, if you have our type of box, the front panel doubles as the heatsink.

Drill the 2N2955 mounting holes and the LED mounting holes first. The only other hardware preparation is the holes for the pc board mounting and the holes for the wires and the terminal block to which they lead.

After the drilling is done, assemble the boards. The first should have all components fitted. It is best to include D1 to D4 even if you have a dc supply, as the unit can then not be connected the wrong way around, and can still be used with ac later on if required. Only if the dc is too low to tolerate the diode drops should D1 to D4 be omitted — i.e : below 12 volts average. (Omitting the diodes will let it run on around 10 volts.) It should also be noted that the supply will have to be a bit higher if the car set is a 12 volt type — around 15 volts at least. An 18 Vac transformer is ideal in that situation. Fit all the components on the boards as shown in the overlay, starting with resistors and finishing with the IC. Take care with the IC orientation.

Once the boards are assembled, connect the flying leads as shown in the assembly diagram. The current-limiting resistors for the track LEDs are mounted behind the LEDs themselves, as part of the flying leads. We used an ordinary plastic terminal block as these are cheap and wires will probably not have to be connected and disconnected repeatedly, so that more 'flashy' terminals are not justified.

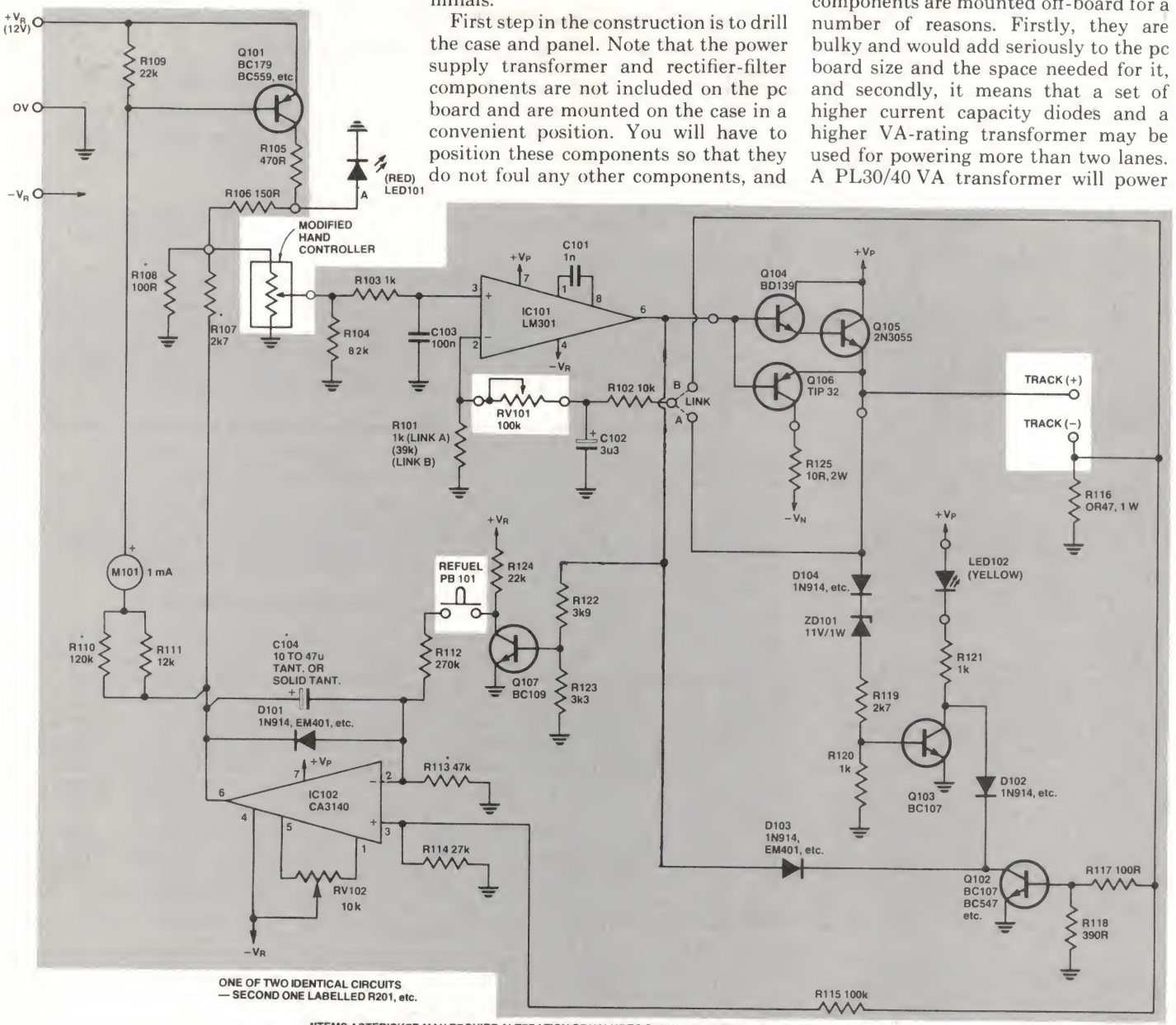
Once the assembly is complete, label the panel and connector appropriately. We used Dymo tape, again in the interests of cost. There is no reason why you should not use paint and Letraset on the panel before assembly, or do a custom job with model paint after assembly, if you should be that way inclined. (Shades of certain panel vans we have seen! Probably more appropriate if your cars are hotrod types.)

Construction ETI-825

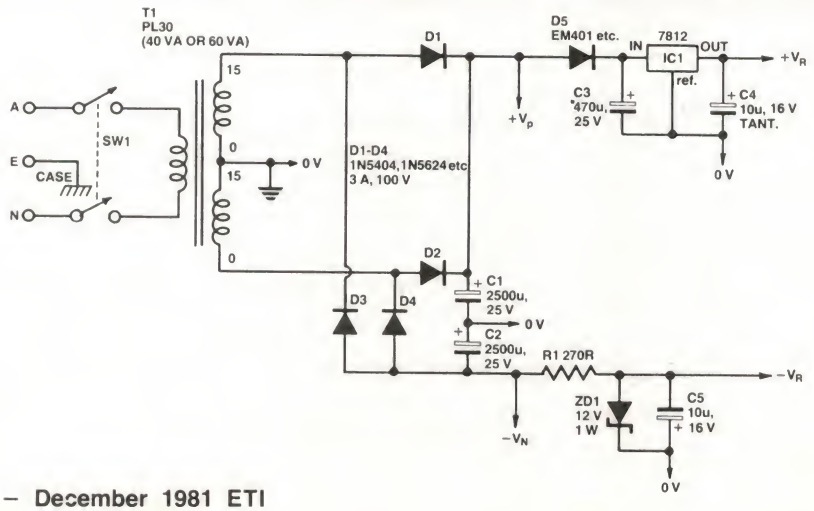
Construction of this unit is fairly flexible and will depend somewhat upon how you plan to house the unit. We built two prototypes — one very compactly in an extruded aluminium case from Amtex and one in a large plastic case from Vero (distributed by Warburton and Franki). It is advisable to use a fairly spacious housing as this demands less careful layout and allows easy access for adjustment or debugging. The only requirement for the case is that if you are using our pc board the meters must be spaced horizontally by the required amount, as ▶

the board mounts on the meter terminals.

First step in the construction is to drill the case and panel. Note that the power supply transformer and rectifier-filter components are not included on the pc board and are mounted on the case in a convenient position. You will have to position these components so that they do not foul any other components, and drill the case to suit. The power supply components are mounted off-board for a number of reasons. Firstly, they are bulky and would add seriously to the pc board size and the space needed for it, and secondly, it means that a set of higher current capacity diodes and a higher VA-rating transformer may be used for powering more than two lanes. A PL30/40 VA transformer will power two lanes, a PL30/60 VA will power up to four lanes.



*ITEMS ASTERISKED MAY REQUIRE ALTERATION OF VALUE TO SUIT YOUR PARTICULAR REQUIREMENTS — SEE TEXT.



We found it convenient to mount the mains supply terminating block, cable clamp (or clamp-grommet), output terminals and presettable pots (RV101, RV201) on the rear panel of our box. We used ordinary potentiometers for RV101 and RV201, rather than preset types, cut the shafts short and cut a slot in the end of the shafts. To avoid fouling other components, mount the pots so that they are below the height of the transformer.

Next, prepare the front panel. Naturally, drill it first. Locate the meter holes carefully as the pc board determines their spacing (144 mm centre-to-

HOW IT WORKS — ETI-825

The unit comprises a power supply, a control section (involving IC101), a driver circuit (involving Q104, 5 and 6 and associated components), an overload protection and warning circuit (Q102, 3 etc), an 'electronic fuel tank' (Q101 plus IC102 and associated components) and a 'refuel' circuit (Q107 etc).

The circuit has two modes of operation — voltage and current. The mode to be employed is selected by means of a link on the pc board. In the voltage mode, the hand controller sets the voltage delivered to the track (and thus the slot car's motor). In the current mode the hand controller sets the current delivered to the car's motor via the track. In either mode, a potentiometer (RV101) sets the maximum value of the voltage or the current.

POWER SUPPLY

Transformer T1 has two 15V (RMS) secondaries, connected in series. There are two rectifier circuits — one to provide a positive supply rail, the other to provide a negative supply rail. The joining of the two secondaries provides a 0 V connection.

Diodes D1-D2 and capacitor C1 provide a nominal +21V supply rail ($+V_P$) while D1-D3 and C2 provide a nominal −21V supply rail ($-V_N$). From these two rails +12V and −12V regulated rails are derived. The +12V rail is achieved by IC1, a three-terminal positive supply regulator (a 7812 or 78L12). This rail is used as a reference for the hand controller and metering circuit. Capacitor C4 ensures high frequency stability for the three-terminal regulator and acts as a supply rail bypass. The −12V rail is derived by a simple zener circuit involving R1 and ZD1. C5 is a supply rail bypass. The negative rail is limited to 12 volts so that the maximum supply voltage limitation of the op-amps, which is about 36 volts, is not exceeded.

CONTROL SECTION

This centres on IC101. A certain current (which we will discuss in detail a little later) is passed through the hand controller resistance. This develops about 200 millivolts drop across it. Thus, when the hand controller is operated, a voltage ranging between 0 and 200 mV is applied to pin 3 of IC101, the precise voltage depending on how far the 'driver' has depressed the controller lever. Capacitor C103 smoothes out any variations — many hand controllers have momentary loss of contact between the wiper and the resistance as the wiper traverses the resistance element. You may need to vary the value of C103 according to how coarse the resistance variation happens to be in your controller. For the inexpensive controllers — which are really quite adequate despite the coarse variation they provide — a value of 470n to 1u (electro) is suitable.

Now, IC101 attempts to drive its output (pin 6) in such a fashion as to induce the same voltage on its inverting input (pin 2) as is on its non-inverting input (pin 3).

In the voltage mode, pin 2 of IC101 is connected via RV101, C102 and associated components to the positive track terminal so that the position of the wiper on the hand control resistance sets the output voltage. In the current mode, pin 2 of IC101 is connected to the end of the 'current sense' resistor (R116) so that current is defined by the position of the wiper on the hand controller resistance.

In either mode, RV101 — which is in series with the negative feedback path — in conjunction with R101, sets the maximum voltage or current delivered to the car's motor via the track. Capacitor C102 induces some 'overshoot' in the feedback which enhances acceleration and braking according to controller movement.

DRIVER

The driver circuit comprises Q104, Q105 and Q106 plus R125. Its function is merely to amplify the current delivered from the output of IC101.

Transistors Q104 and Q105 are connected as a Darlington pair which provides considerable current gain (the Beta of Q105 is multiplied by the Beta of Q104). The output of IC101 (pin 6) swings positive during acceleration (depressing the hand controller lever) and Q104-5 amplify the current, the emitter of Q105 being connected to the track positive terminal. Q106 is reverse biased during this time. During braking, pin 6 of IC101 can go negative (particularly if you 'drop' the hand controller lever). This reverses the voltage delivered to the track or reverses the current flow (depending on which mode you're employing). When this occurs, Q104 and Q105 are reverse biased and Q106 is forward biased — and it amplifies the negative excursions from pin 6 of IC101.

The function of R125 is to protect Q106 against momentary current overload.

PROTECTION

The protection circuit involves Q102, Q103 and associated components. If the voltage output to the track exceeds about 13 volts, ZD101 and D104 conduct, forward biasing the base of Q103. When Q103 turns on, it draws collector current via LED102 and R121. LED102 lights, providing warning of a fault. If the output current exceeds about 1.5 amps the current through R116 (which is in series to the supply to the track) induces a voltage drop across it of about 0.7 volts or so and this forward biases the base of Q102 via R117 and R118. Q102 thus turns on and it draws collector current via D102, R121 and LED102. However, the collector voltage of Q102 will be around a few hundred millivolts and the output of IC101 (pin 6) will be shunted to the 0 V rail via D103 and the collector-emitter junction of Q102.

Thus, you receive a warning of supply overload and the supply, track etc., is protected against overcurrent damage.

FUEL TANK

The 'fuel tank' is simulated by IC102 and associated components. This op-amp is connected as an integrater. A 'full' tank corresponds to 0 V on the output of IC102 (pin 6), an 'empty' tank to about 12 volts. As current flows through the load (car motor), and hence via R116, a voltage is dropped across R116. This voltage is integrated by IC102 which has an RC network (R113-C104) in the feedback loop. As more load current is drawn, pin 6 of IC102 rises towards 12 volts.

The meter, M1, indicates the output voltage of IC102 and is marked like a fuel guage. While the fuel tank is full or partially full, the current through M1 flows via the base of Q101, forward biasing it. Thus, Q101 is held on while this current flows. The collector current of Q101 flows via LED101 (the hand controller and associated resistors). LED101 lights, indicating you have fuel in the tank. When the fuel 'runs out', pin 6 of IC102 is at 12 volts and no current flows through M1 and thus the base of Q101 receives no bias and it turns off. LED101 extinguishes at this stage and no voltage is delivered to the hand controller. IC101 interprets this as if you have the controller set to the rest or off position and no power is supplied to the track. Your car stops . . .

The 'capacity' of the fuel tank is defined by the values of C104 and R113. The values shown give a 'full tank' of about 60 amp-seconds — which corresponds to about 30 rapid laps of a 2½ metre long track in 1/64th scale. The values of C104 and R113 may be varied to suit your taste, as indicated in the table on page 33.

While there is fuel, LED101 is on and its terminal voltage is about 1.7 volts. This voltage permits about 10 mA to flow through the resistance of the hand controller via R105. (Recall we have yet to see what its current is). In addition, R107 permits some current to flow into the controller— generally between 0 and 5 mA — from pin 6 of IC102. This current increases as fuel is 'used up', corresponding to the car getting lighter, and you get more acceleration at any particular hand controller setting as you 'use up' fuel. Resistor R107 defines how much more acceleration is obtained when the car is 'lighter'.

When the fuel runs out and Q101 turns off, the current delivered through R105 to the hand controller plummets and only the 5 mA flowing via R107 is available. This gives a 'soft' end, allowing you to limp to the pits — if you aren't too far away on the track.

The parallel combination of R108 and the hand controller should be around 15 ohms. If your controller has a high resistance, or you want to substitute a 1k wirewound pot, for example, R108 should be derived from the following formula:

$$R108 = \frac{1}{\left(\frac{1}{15} - \frac{1}{R_{controller}}\right)}$$

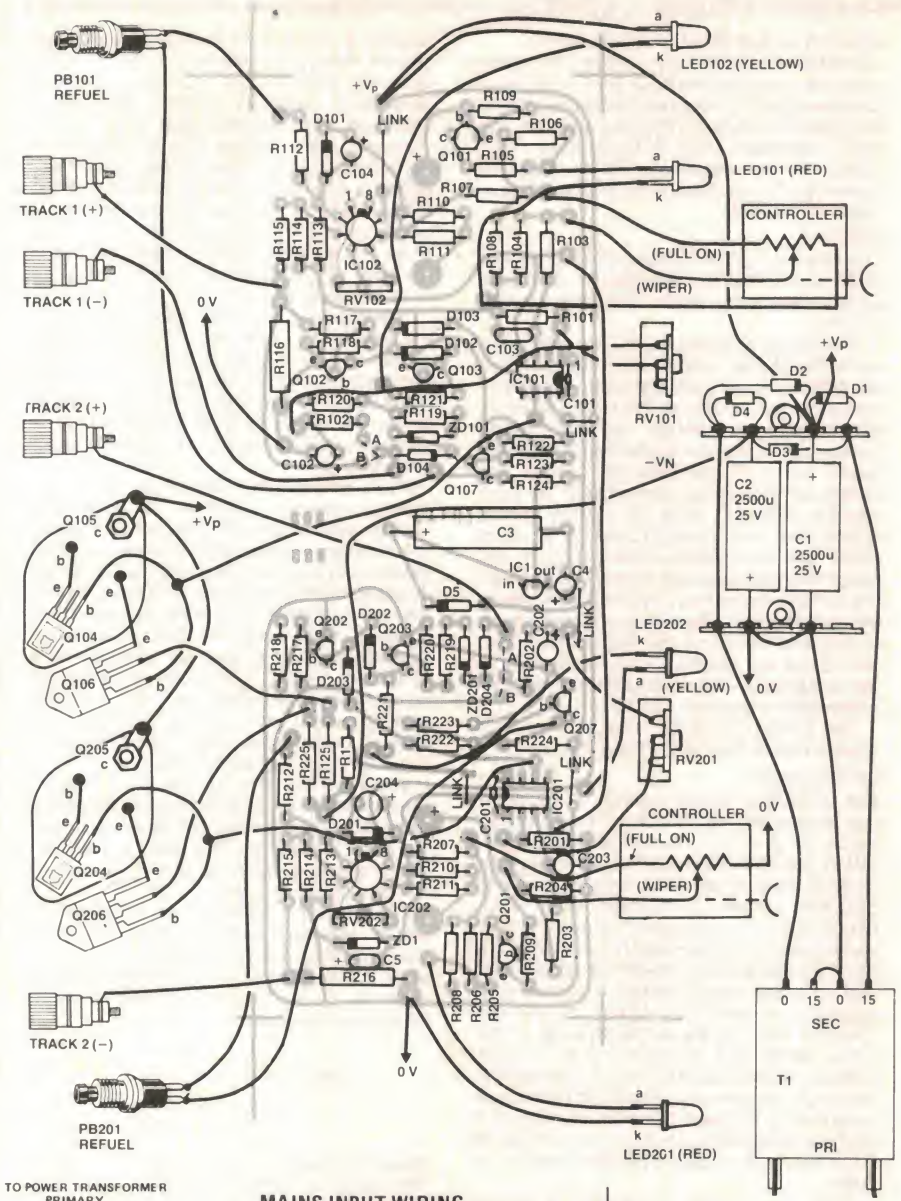
REFUEL CIRCUIT

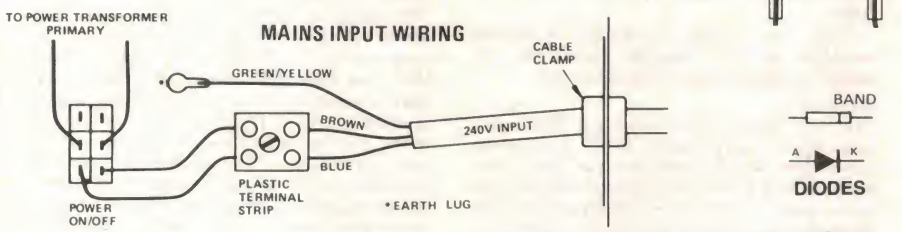
'Refuelling' is effected by PB101 and Q107. When the car motor is not drawing power, the output of IC101 (pin 6) is low (less than one volt) and thus Q107, which derives its base bias from pin 6 of IC101, is off. Pressing PB101 connects R112 to the +12 V rail via R124 and IC102 will discharge C104. The output of IC102 (pin 6) will drop to 0 V (which is the 'tank full' condition). Q101 will turn on again and current will be supplied to the hand controller circuit. When you power the car again, the voltage on pin 6 of IC101 will rise, the base of Q107 will be biased on and its collector will draw current via R124. Thus, if you try to 'top up' while the car is in motion, R112 will be virtually connected to the 0 V rail via the collector-emitter junction of Q107 and you won't be able to drive the output of IC102 low. In addition, if you attempt to drive the car while refuelling, the refuelling action will be stopped by the same means.

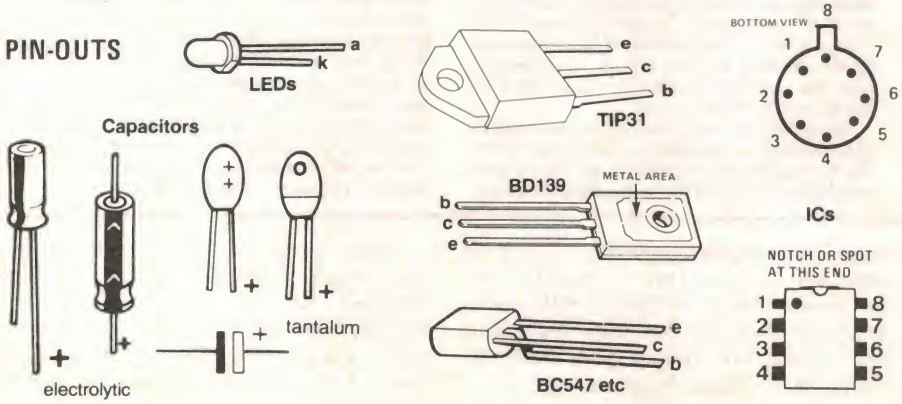
centre). For panel marking we used rub-down lettering on one panel (such as Letraset, Geotype, etc), put directly on the panel after cleaning it, and automotive 'touch-up' paint on the other. Both methods proved satisfactory. In the interests of giving a Spartan, vehicular look we put '?' symbols near the overload/fold warning LEDs and '!' symbols near the fuel warning LEDs, but words are OK if you need the controller to be self-explanatory.

Apply a spray-on lacquer to protect the panel markings. With this job finished, fit the meters, LEDs, etc. Finally, drill the mounting holes for the power transistors, which are mounted off the board. These dissipate little heat so ▶

The pc board artwork for each project appears on page 147.







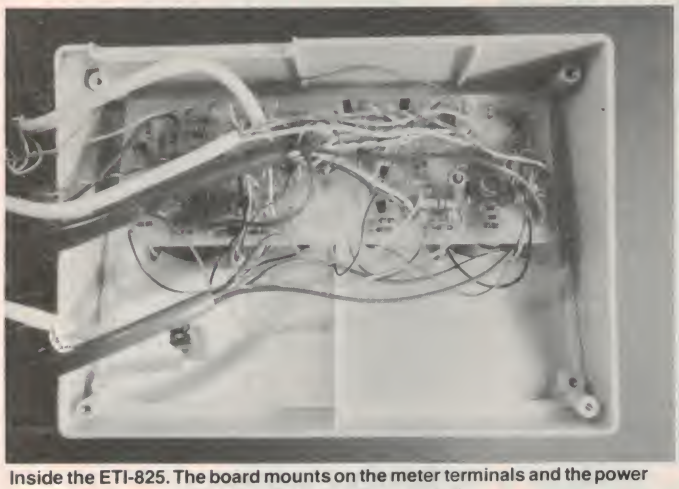
they merely need mechanical support.

The next step is to assemble the components to the pc board. As there are quite a few flying leads, it may pay to use pins for the termination of these to the pc board. Pay attention to all the usual details — orientation of tantalum and electrolytic capacitor, orientation of semiconductors, etc. Choose the components in Table 1 to suit your requirements, according to the instructions given with the Table. When all the components are soldered in place, fit the flying leads to the LEDs and pushbuttons which are mounted on the front panel, along with the meters. These can be secured and the pc board bolted to the meter terminals before the leads to the main case are fitted. Be sure that all flying leads are long enough to allow the box to be fitted together and dismantled without straining the connections. In the controller we assembled in the extruded aluminium case, very long wires were required as the panel has to be slid into position end-wise because it rides in a groove of the extrusion. Long leads can be kept neatly 'loomed' with plastic sleeving slipped over a bunch before one group of ends is terminated.

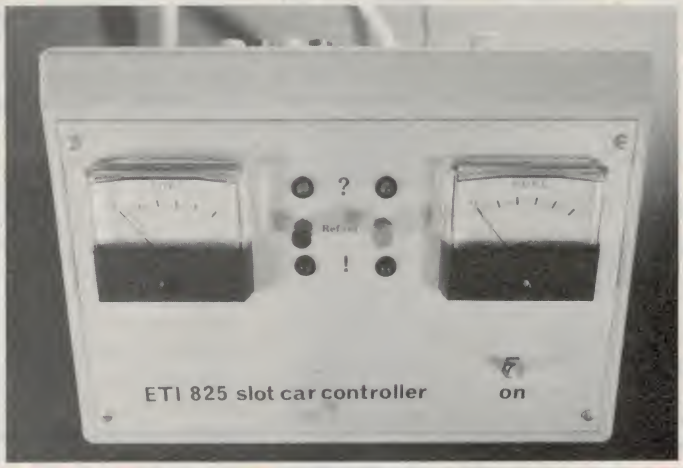
Assemble the transformer, power supply components and potentiometers in the case next and wire them up. Take particular care with the mains wiring. The rectifier components are supported on a tagstrip and we'll leave the wiring details to you for this one.

The final step before testing is to modify the handheld controllers from rheostats to true potentiometers. Open up the case of a controller. You will find that it consists of a short coil of resistance wire, wound on some sort of former, with a wiper contact which moves along the coil according to how far the thumb or finger control is depressed. When fully released, the wiper rests in a position where it does not touch the coil. There will be two wires coming from the hand controller — one leading to the wiper and one from an end of the resistance wire. It is neccesary to have a third contact, connected to the other end of the coil (the end without a connection). Remove the existing wires (some of these have considerable resistance themselves) and fit the two new wires, then the third. These run to the controller unit. Make sure you have plenty of length to play with. Now re-assemble the hand controller, being careful to tie off the wires in the same way the original two were secured.

You should now be ready for a test run.



Inside the ETI-825. The board mounts on the meter terminals and the power supply and other components mount in the cabinet base.



Full frontal view of the ETI-825 'control' panel.

TABLE 1. Component value variations

Component	Nominal Value	Function	How to vary it
C104(C204)	10u	Sets fuel tank capacity, along with C104.	Increase its value to increase fuel tank capacity. E.g: 20u gives double capacity. RANGE: 10 to 47u
R113(R213)	47k	Sets fuel tank capacity, along with C104.	Increase its value to increase fuel tank capacity. RANGE: 10k to 100k
R110(R111)	120k in parallel with 12k.	Calibrates M1 for full scale deflection at 'full tank' status; allows other meter fsd values to be used.	Reduce R110 to increase reading. Choose R110/R111 to give value according to $11.4/I_{fsd}$. This should not need much adjustment if a 1 mA meter is used.
R107	2k7	Sets the variation of engine power remaining fraction of fuel.	Reducing R107 gives a greater gain in power as the fuel 'runs out'. RANGE: 2k2 to 22k.
R108	100R	Sets the effective controller resistance to about 15 ohms.	Choose R108 such that R108 in parallel with the controller resistance gives a combined resistance of 15 ohms.

PARTS LIST—ETI-825

Resistors ..... all ½W, 5% unless noted
R1 ..... 270R
R101 ..... 1k (link A), 39k (link B)
R102 ..... 10k
R103,120,121 ..... 1k
R104 ..... 82k
R105 ..... 470R
R106 ..... 150R
R107 ..... 2k7*
R108 ..... 100R*
R109,124 ..... 22k
R110 ..... 120k*
R111 ..... 12k
R112 ..... 270k
R113 ..... 47k*
R114 ..... 27k
R115 ..... 100k
R116 ..... 0R47, 1W
R117 ..... 100R
R118 ..... 390R
R119 ..... 2k7
R122 ..... 3k9
R123 ..... 3k3
R125 ..... 10R, 2W
RV101 ..... 100k lin. pot.
RV102 ..... 10k

Capacitors
C1 ..... 2500u/25 V electro.
C2 ..... 2500u/25 V electro.
C3 ..... 470u/25 V electro.
C4, C5 ..... 10u/16 V tant.
C101 ..... 1n greencap
C102 ..... 3u3/10 V tant.
C103 ..... 100n greencap
C104 ..... 10 - 47 u/16 V tant. — preferably solid tant.

Semiconductors
D1-D4 ..... 1N5404,1N5624 etc (3A, 100V)
D5,D101,D103 ..... 1N4001,EM401, (1A,100V)
D102,D104 ..... 1N914, 1N4148
ZD1 ..... 12 V, 1 W zener
LED101 ..... TIL220R, red
LED102 ..... TIL220Y, yellow
Q101 ..... BC179, BC559 etc
Q102,103 ..... BC107,BC547 etc
Q104 ..... BD139
Q105 ..... 2N3055
Q106 ..... TIP32
Q107 ..... BC109,BC549
IC1 ..... 78L12 or 7812
IC101 ..... LM301
IC102 ..... CA3140

Miscellaneous
T1 ..... PL30/40 VA (or 60 VA), Ferguson (2 x 15 V, 1A)
SW1 ..... SPST, 240 Vac rated toggle switch
M101 ..... 1 mA meter, MU-45 or similar
PB101 ..... momentary action pushbutton

ETI-825 pc board; case to suit; tagstrips; terminal block; mains cord and plug; clamp grommet; Scotchcal meter scales; nuts, bolts, wire etc.

NOTE: The controller circuit is duplicated for the second track and those parts marked R101, D101, C101, IC101 etc are duplicated, designated R201, D201, C201, IC201 etc for the second controller.

* Components marked with an asterisk may require alteration to suit your particular requirement (see text).

Price estimate

We estimate the cost of purchasing all the components for this project will be in the range;

$60—$70

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project, such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel supplied (if used), etc — whether bought as separate components or made up as a kit.

Test run

Make up a simple circle of track. On powering up, the car should work to some degree. If not, stop and recheck. Once it works it is necessary to adjust the presets and so forth. RV102/202 should be adjusted to minimise 'fuel tank' circuit drift in the absence of power being delivered. (These are the integrator offset adjustments.) At this stage it is probably worth assembling the unit and giving it a serious workout. You may find that you want to increase the fuel tank capacity (C104), change from one mode to the other (links A and B) or that the control is rough or jittery. If this latter is the case, then your controller is probably one with *relatively few* turns of resistance wire. This is causing sharp changes in level, to which the electronics respond with excessive overshoot. The cure is to increase C103/203 to, say, 1 μF. This is especially prevalent with the cheap, 6 V operated sets. After you have had a while in the seat, remove the front panel and alter the appropriate components (marked with an asterisk) in order to produce the effects desired. To figure out what these are, consult Table 1.

A note should be included on the correct adjustment of the maximum torque presets, RV101/201. This is much a matter of preference. They should be ▶

Modified hand controller with connection to both ends of resistance wire.

adjusted so that the car does not get ridiculous amounts of power just prior to running out of fuel, but so that the car can just be crashed on full power with a full tank. It is probably also a good idea to set the two channels alike with a multimeter to ensure fairness. (Be sure to have equal amounts of fuel when doing this adjustment!)

The track

When it comes to track, there are three factors worth mentioning which may influence your choice if you have yet to purchase it, before we discuss actual layout. These factors are: range of pieces available, flexibility and width. If you are going to buy the cheap sets, and let's face it, that is the most cost-economical approach, you will have to accept that the track comes in fixed quantities, probably multiples of what it takes to make up one loop or a small figure-8. However, it is so cheap that you can get twelve 45° curves and four straights, not to mention two cars and controllers, and fences, etc, for under $15 in some places in Sydney (e.g.: Paddy's markets, etc). For $30, plus one of our controllers, you can get a really good set-up, and for $45 you get a really *fantastic* set. There is no denying that an expensive brand is better in that you can buy three radii of curvature (for funny bends or up to six lanes) and several lengths of straight, but at $150 or so for a basic figure-eight set, it is not a purchase to be taken lightly. Such sets also have the advantage that they have flexible track which can thus be banked on the curves, but they are on a larger scale and take up more room. The cheap stuff is usually about 102 mm (4″) wide, but if you are lucky you can get it a bit wider, like 110 mm. This is a bit better, as the cars are less likely to interfere with each other on bends, and less likely to foul badly on fences.

In designing a layout, the main problem is not to find a shape which is particularly interesting, but one which is fair, or equal, for both lanes, as well as 'rational'. By rational we mean that the pieces of track fit together into a loop naturally and require no forcing. A layout which has to be pushed out a bit to meet up is not only unaesthetic to the perfectionist mind, but tends to rapidly separate in various places with a bit of use. If you are using the track pieces which come in the cheaper sets you are probably constrained to turn increments of 45°, and straight sections each equal to the centre radius of curvature of the curved sections. If, in addition, you want to use all or almost all of the track available, (and who doesn't?), you are probably constrained to some fixed ratio of curves-to-straights. Even if you are lucky enough to have a range of bits, it is quite challenging to sort out a fair and rational track using all the bits. And besides, who rushes out and gets that quarter straight every time he devises a nice-looking layout that doesn't quite meet up squarely?

Method

If you are not seriously interested in layout analysis and design, you may skip this paragraph; it deals with our mathematical method of thinking out a track set-up. First, let us define some terms. A 'construct' is any group of track sections. It does not necessarily meet up to form a closed loop, but is usually a familiar shape which can be found in common layouts. A rational construct is one which replaces a basic subsection of an oval of track — either a right angle, a single straight section, or a combination of these — and thus, geometrically, introduces an integral multiple (or in some sets of track, a simple rational fraction) of the basic radius of curvature into each axis.

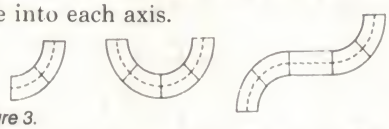


Figure 3.

To explain this, consider Figure 3. The right angle turn introduces a one-unit displacement down and one unit along. The U-bend introduces a two-unit shift down and no shift along. The S-bend introduces three down, and two along. These are all rational constructs in the system of track here — that is, one where straights are exactly one radius of curvature long, as is common. The constructs in Figure 4 are all equivalent to a right angle, and are thus rational.

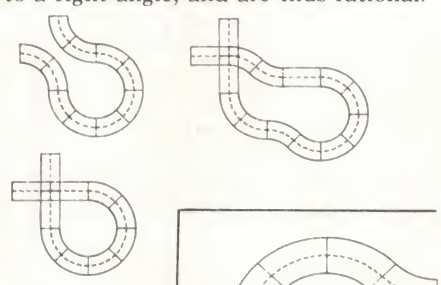


Figure 4.

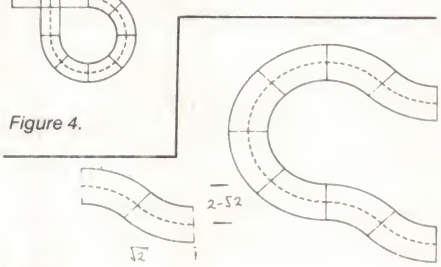


Figure 5.

The zig-zag in Figure 5 is irrational, as it has displacements of $\sqrt{2}$ and $2-\sqrt{2}$ respectively, but the construct next to it is rational, as the zig-zags clearly cancel out.

A layout is said to be *rational* if it fits together *exactly*. For this to happen, there must be no uncancelled irrational constructs. Some constructs favour one lane. For instance, in a plain 180° bend, the outside lane is longer, and thus you might expect it to take longer to negotiate. If there are fences it may be faster, as the car can bounce off them and thus use them to allow greater speed without accident.

Experiment will determine how each construct favours lanes. In our experience, a zig-zag favours the lane first on the outside, especially with fencing. Once you have an idea of each construct and how it favours lanes, you can assemble them into a fair layout. Even though a completely flat layout will inevitably have one lane longer on the outside, it can be made fair by judicious addition of constructs to favour the worse lane — such as zig-zags at the ends of long straights.

It is desirable to avoid bridges, because they are easier to disrupt in moments of excitement as well as harder to achieve with rigid track. It is also a pain to quickly recover a crashed car from the underpass. Flat layouts can be fair, with some thought and understanding of the constructs used.

Finally, let us mention cleaning. Unless rust is rife, abrasive things such as emery paper should be avoided. Cloth soaked with methylated spirit is best for removing crud. After cleaning, light application of machine oil or Vaseline (the latter collects more hair but is better for storage) will reduce crudding and prevent corrosion. The plating on the tracks is sufficient protection until it fails, so just wiping should be enough. Occasionally, the small metal flanges which make contact from track to track should be bent slightly to improve friction and contact.

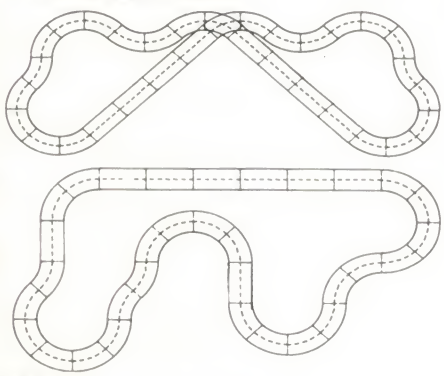


Figure 6.

If you are really getting into it, you can devise a catalogue of constructs. We developed a computer program for checking rationality and a layout plotting routine; we tender a couple of optimal layouts (Figure 6) which use all the track from two cheap figure-eight sets. The analysis and synthesis of track layouts becomes more complex when you have different and more varied pieces available — our examples are of the elementary type, as in cheaper sets. ●

ROD IRVING ELECTRONICS

425 HIGH STREET, NORTHCOTE 3070. MELBOURNE. PH (03) 489-8131

KITS

Please phone or write for full list of kits available

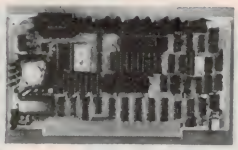
THIS MONTHS KITS

ETI-824 SLOT CAR SUPPLY
The simple, inexpensive solution
P.O.A.

ETI-825 SLOT CAR CONTROLLER

The all-singing, all-dancing controller featuring electronic fuel tank, protection, etc, etc.
P.O.A.

ETI-159 10-15 V METER



Expanded scale meter for 12 V battery systems, power supplies, etc.
P.O.A.

NOW A $99 Computer!

Plugs into any TV!
ETI 660

No one would have believed it a few years ago. Features include: colour capability, operates from optional 9V plugpack, 1K memory expandable to 3K on-board, single board construction, cassette interface, audio output (play tunes), simple to program (uses Chip-8). Expansion projects coming up include: ASCII keyboard, light pen, games software etc. (So we are told).

Starter Kit, (1K RAM, B&W video)	$99.00
9V, 200mA plugback to suit	$6.50
Colour video option	$8.00
RAM EXPANSION (add to PCB)	$16.00

As with all new kits, please phone first to check stocks. We expect the kit to be in stock some time in Oct. 1981.

EA DIGITAL STORAGE CRO KIT

$78

ETI 256 HUMIDITY METER

$19.50

ETI330 CAR ALARM

$32.00

ETI 329 Expanded Scale Vehicle Ammeter

$17.00

ETI 458 LED LEVEL METER

$27.50

ETI 572 Digital PH Meter

$97.50

ETI 567 Core-Balance Relay

$42.00

UNIVERSAL RELAY BOARD ETI 257

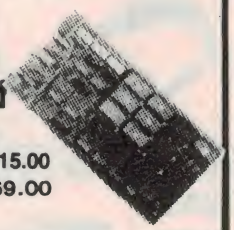
$12.50

ETI 258 MINI DRILL CONTROL

ETI 475 AM Tuner

Case slightly different from one shown. $89.00

S100 Prom Board
ETI 682
KITS $115.00
PCB $69.00



ETI 476 Series 3000

$84.00

ETI 568 Light & Sound Flash Kit

$25.00

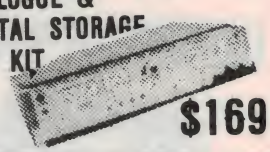
Series 5000 Mosfet $275.00
Series 5000 Preamp $235.00

ETI 477 Series 5000 Mosfet Power Amp
All parts individually available
$58.00
COME IN AND HEAR THE SOUND

KITS

Playmaster Graphic Analyser kit	$99 50
EA 79SF9 Sound Flash Trigger	$15 00
ETI 585R Ultra Sonic RX	$15 95
ETI 585T Ultra Sonic TX	$8 95
ETI 576 Electromyogram kit	$89 00
ETI 147 Oct 80 Electronic Load kit parts	$75 00
ETI 327 Turn Hazard Unit kit parts	$22 00
EA Car Battery Voltage Monitor Oct EA kit parts	$6 50
EA Bipolar Train Controller Nov 80 kit parts	$26 00
EA Digital Storage CRO Adaptor Nov 80 kit parts	$78 00
EA Light Beam Relay Nov 80 kit of parts	$13 00
EA RS232 Printer Interface Nov 80 kit parts	$15 00

ANALOGUE & DIGITAL STORAGE CRO KIT



$169

EA Digital Engine Analyser Oct 80/80TM8a 10 Kit parts inc. front panel $49.50

ETI 729 UHF TV Masthead

$34.00

ETI1501 Negative Ion Generator

$39.00

Bankcard Mail Orders Welcome
Please debit my Bankcard

Bankcard No .....
Expiry Date.....
Name.....
Signature ..... ETI 2/11/81

TO ORDER: Heavy items sent Comet Freight on. Mail Order phone 481-1436. Wholesale Customers phone: RITRONICS WHOLESALE 489-7099. Mail Orders to P.O. 235 Northcote 3070. Minimum P&P $2. Add extra for heavy items, registration and certified mail. Prices. spec. subject to change without notice.

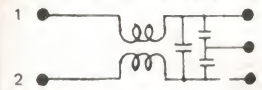
ROD IRVING ELECTRONICS
425 HIGH STREET, NORTHCOTE 3070. MELBOURNE. PH (03) 489-8131

XMAS Specials from JAYCAR!!

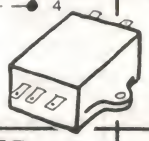
A VERY MERRY CHRISTMAS TO ALL READERS AND CUSTOMERS FROM JAYCAR

AT LAST! AN ECONOMICAL MAINS FILTER!! 250VAC @ 3A

250V AC @ 3A. Insertion loss: line-to-line 20dB 0.8 - 30MHz. Line-to-ground 30dB 0.7 -30 Ideal for computers, amps etc.



ONLY $14.50



SILICON GREASE REALISTICALLY PRICED

Up until now you have had to buy a lifetime quantity of silicon grease in an expensive medical syringe package. Now you can buy all that you are ever likely to need for HALF commonly charged!

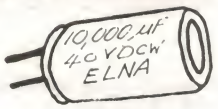
SAVE 50%

disposable tube!

only 1.25

10,000uF 40V ELECTROS

Single ended, suitable for computer power supplies, amplifiers or general power supplies.
Compact and economical QUALITY ELNA BRAND



$6.75 GREAT VALUE

BURGLAR ALARM PRESSURE MATS TWO SIZES

Two sizes: small 530x180mm ideal for staircase use
large 780x550mm ideal for general use

DOORBUSTER SPECIAL 16 PIN IC SOCKET

16 pin I.C. sockets — quality "CAMBION" BRAND
NORMALLY 0.40c EACH
DECEMBER SPECIAL ONLY

only 25¢ ea. normally 40c

over 35% off!!

LARGE BINDING POST SELLOUT

Heavy duty Binding Posts sacrificed BELOW COST! What's the snag? WE ONLY HAVE RED ONES!!!
NORMALLY 0.95c each
FOR DECEMBER ONLY 20¢ ea

* THERMALLOY HEATSINKS

Compact, high quality heatsinks for TO-220 devices.
Horizontal PCB mount type 50c

Vertical clip type 45c

VERY LARGE PANEL METERS —SPECIAL—

MASSIVE 120 x 110mm FACE!! (4¾ x 4¼")
Units feature blank face suitable for any scale markings. 50mV FSD. We only have a few of these High Quality moving coil movements SO HURRY!!!

ONLY $9.50 SUPERB UNITS

STEREO HEADPHONES LESS THAN ½ PRICE!!

Why not shout yourself a High Quality Headphone for Chrissie?
20-20,000Hz
8 ohms
94dB sensitivity
Separate level controls,
2.4m cord and very lightweight

SAVE $10

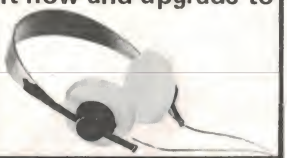
only 9.95 normally $19.95

SENNHEISER STEREO HEADPHONES

We stock the headphone that is now in use on the TAA A-300 Airbus (first class). Why not take advantage of the low price of this unit now and upgrade to Sennheiser quality?

We also stock the 'classic' Sennheiser HD-414-13 unit. This is the Hi Fi industry standard unit
ONLY $69.00

HD 40-13 ONLY **$29.95** You thought they would be dear didn't you!!



NEUTRIK — XL Type Connectors (pronounced NOY—TRIK)

We now stock these fine Swiss made connectors as well as Cannons. . . .
FEATURES: *Special Polyacetal cable clamp and Nylon strain relief bushing. *More than 10,000 insertions/withdrawals without nificant wear. *Solid die-cast body. *Glass reinforced contact insert material will withstand high solder temperatures. *Positive spring steel retention back. *Shell connected to grounding lug.

3 pin line socket plain finish silver contacts	$4.95
3 pin line plug plain finish silver contacts	$3.95
3 pin line socket black finish gold contacts	$6.65
3 pin line plug black finish gold contacts	$5.25
¼" (6.5mm) phone plug pro-quality. Neutrik clamp	$4.50

* AT LAST * programmable master rhythm generator

FULLY IMPORTED

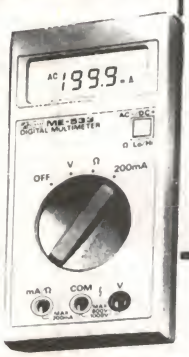
This project was originally described in the UK publication "Practical Electronics". We have fully imported "Clef" kit
This attractive kit is presented in an attractive metal cabinet with silkscreened front panel.
The Master Rhythm can be programmed (in RAM) to play back:
— 24 Rhythm patterns 8 parallel tracks 12 instruments
It is also capable of sequence operation — the ULTIMATE UNIT

complete SEND SAE FOR DESCRIPTIVE LEAFLET

$199 LOW POWER BATTERY DRIVEN

SELLING FAST BE QUICK

HAVE YOU SEEN OUR $49.95 AUTO RANGING DMM?? IT'S A PRICE BREAK THROUGH



20 amp shunt $7.50

VIDEO CONNECTORS

7 pin DIN line plugs and sockets

LINE PLUG ONLY	90c
LINE SOCKET ONLY	98c

Jaycar

NOTE! NEW SHOP HOURS
Mon - Sat 9am — 5.30pm
Sun - 10am — 2pm
Open Thursday night until 8pm.

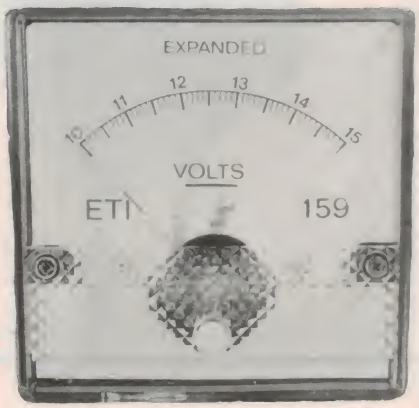
380 Sussex St Sydney 2000
Ph. 2646688 Telex 72293
Mail Orders To: Box K-39 Haymarket 2000

Expanded scale voltmeter covering the 10 - 15 V range

A simple, low-cost instrument that can be built into power supplies or used as a portable or fixed 'battery condition' monitoring meter.

Simon Campbell

Roger Harrison



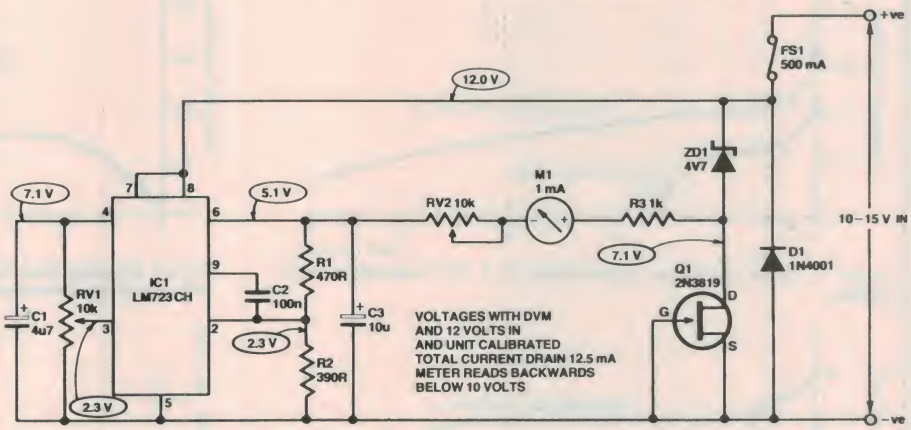
COMMON STORAGE BATTERIES to power nominal 12 Vdc electrical systems have a terminal voltage that ranges from a little over 10 volts when discharged to around 15 volts when fully charged, the operating voltage being somewhere in the range 11.5 V to 13.8 V. Lead-acid batteries, for example, may have a terminal voltage under rated discharge that commences at around 14.2 V and drops to about 11.8 V. A 12 V (nominal) nickel-cadmium battery may typically have a terminal voltage under rated discharge that starts at 13 volts, dropping to 11 volts when discharged.

Equipment designed to operate from a nominal 12 Vdc supply may only deliver its specified performance at a supply voltage of 13.8 V — mobile CB and amateur transceivers being a case in point. Other dc operated equipment may perform properly at 12.5 V but 'complain' when the supply reaches 14.5 V.

To monitor the state of charge/discharge of a battery, a battery-operated system or the output of power supplies, chargers, etc, a voltmeter which can be easily read to 100 mV over the range of interest, i.e: 10 to 15 volts, is an invaluable asset. This project does just that.

Some readers may note that our Expanded-scale LED Voltmeter, Project ETI-316, published in the September 1980 issue, does much the same job. However, the function of each is somewhat different. The ETI-316 has 10 LEDs indicating each half volt between 10.5 V and 15 V and is intended to be read 'at a glance', giving a general indication of battery condition or whatever. Its main application is in vehicles or other areas where operation is only checked periodically.

This instrument, being of the true analogue type, is intended for more exacting measurement and is better characterised as a test nstrument.



The circuit

We originally came across this circuit in an article by Danny Apted (then VK7ZDA) published in 'QRM', the newsletter of the Northern Branch of the Wireless Institute of Australia, Tasmanian Division.

An LM723 variable voltage regulator IC is employed to set an accurate 'offset' voltage of 5 V, and the meter (M1) plus the trimpot RV2 and R3 make up a 5 V meter, with the trimpot allowing calibration. The negative terminal of the meter is connected to the output of the

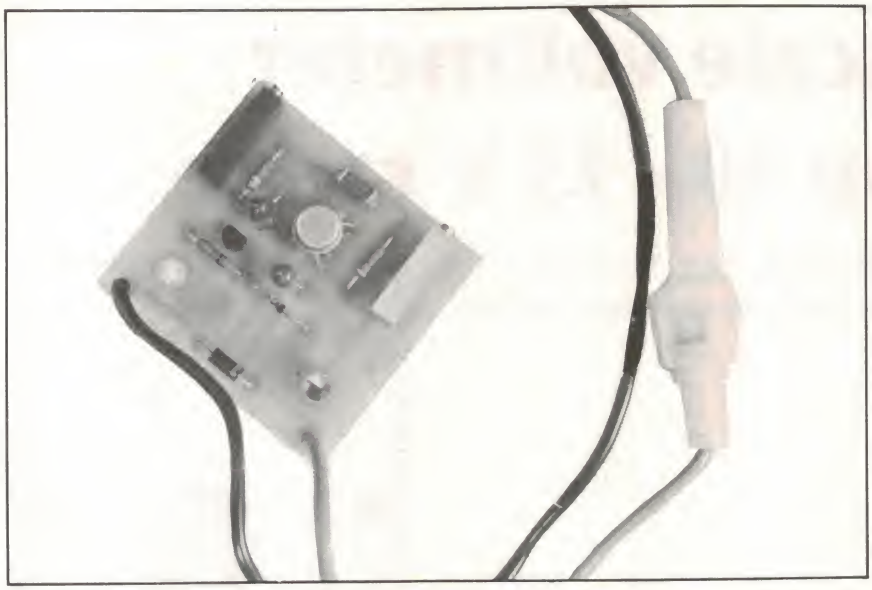
HOW IT WORKS — ETI 159

The meter, M1, is a 1 mA meter with series resistance — made up of R3 and RV2 — so that it becomes a 0-5 V voltmeter. The negative end of the meter is maintained at 5 V above the circuit negative line by the output of IC1, a 723 adjustable regulator. The positive end of the meter is connected to the circuit positive line via ZD1, a 4V7 zener diode. Thus, no 'forward' current will flow in the meter until the voltage between the circuit negative line and the circuit positive line is greater than 5 + 4.7 = 9.7 volts.

Bias current for the zener is provided by a F. E. T, Q1, connected as a constant current source so that the zener current is accurately maintained over the range of circuit input voltage. This ensures the zener voltage remains essentially constant so that meter reading accuracy is maintained.

The trimpot RV1 sets the output voltage of the 723. This determines the lower scale voltage. Trimpot RV2 sets the meter scale range. More resistance increases the scale range, less resistance decreases it.

Diode D1 protects the circuit against damage from reverse connection.



723 so that it is always held at 5 V 'above' the circuit negative line. The positive end of the meter goes to a zener which will not conduct until more than 5 V appears between the circuit +ve and −ve lines. Thus the meter will not have forward current flowing through it until the voltage between the circuit +ve and −ve rails is greater than 10 V, and will read full scale when it reaches 15 V (after RV2 is set correctly).

The meter scale limits may be adjusted by setting the output of the 723 higher or lower (adjusted by RV1) and setting RV2 so that the meter has an increased or decreased full-scale deflection range.

A variety of meter makes and sizes may be used.

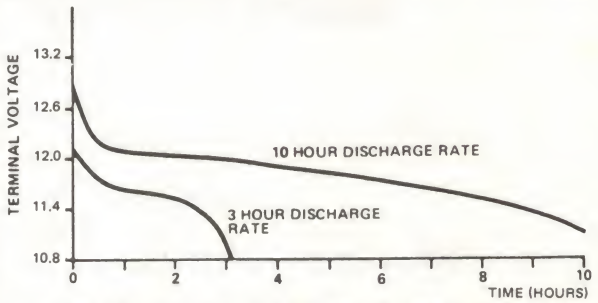


Figure 1. **Typical discharge characteristics of a 12 V (nominal) lead-acid battery.**

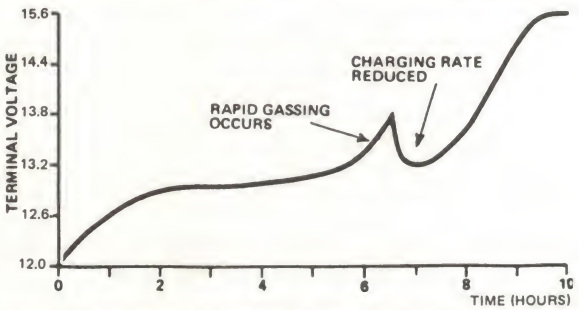


Figure 2. **Charging characteristics of a 12 V (nom.) lead-acid battery. The 'kink' in the curve near 6 hrs is explained in the text.**

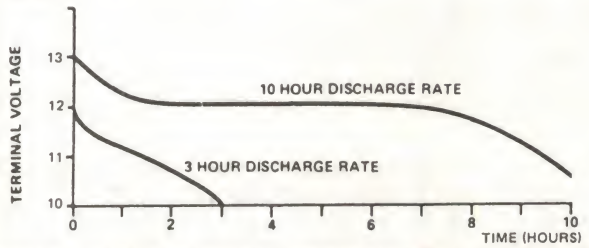


Figure 3. **Typical discharge characteristics of a 12 V (nom.) nickel-cadmium battery (usually consisting of 10 cells in series).**

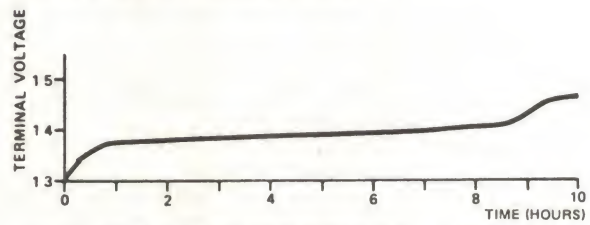


Figure 4. **Typical charging characteristics of a 12 V NiCad battery (10 cells) charged with a constant current at one-tenth rated capacity (0.1C).**

Battery condition and terminal voltage

The 12V battery, in its many forms, is a pretty well universal source of mobile or portable electric power. There are lead-acid wet cell types, lead-acid gel electrolyte (sealed) types, sealed and vented nickel cadmium types, and so on. They are to be found in cars, trucks, tractors, portable lighting plants, receivers, transceivers, aircraft, electric fences and microwave relay stations — to name but a few areas.

No matter what the application, the occasion arises when you need to reliably determine the battery's condition — its state of charge, or discharge. With wet cell lead-acid types, the specific gravity of the electrolyte is one reliable indicator. However, it gets a bit confusing as the recommended electrolyte can have a different S.G. depending on the intended use. For example, a low duty lead-acid battery intended for lighting applications may have a recommended electrolyte S.G. of 1.210, while a heavy-duty truck or tractor battery may have a recommended electrolyte S.G. of 1.275. Car batteries generally have a recommended S.G. of 1.260.

That's all very well for common wet cell batteries, but measuring the electrolyte S.G. of sealed lead-acid or nickel-cadmium batteries is out of the question.

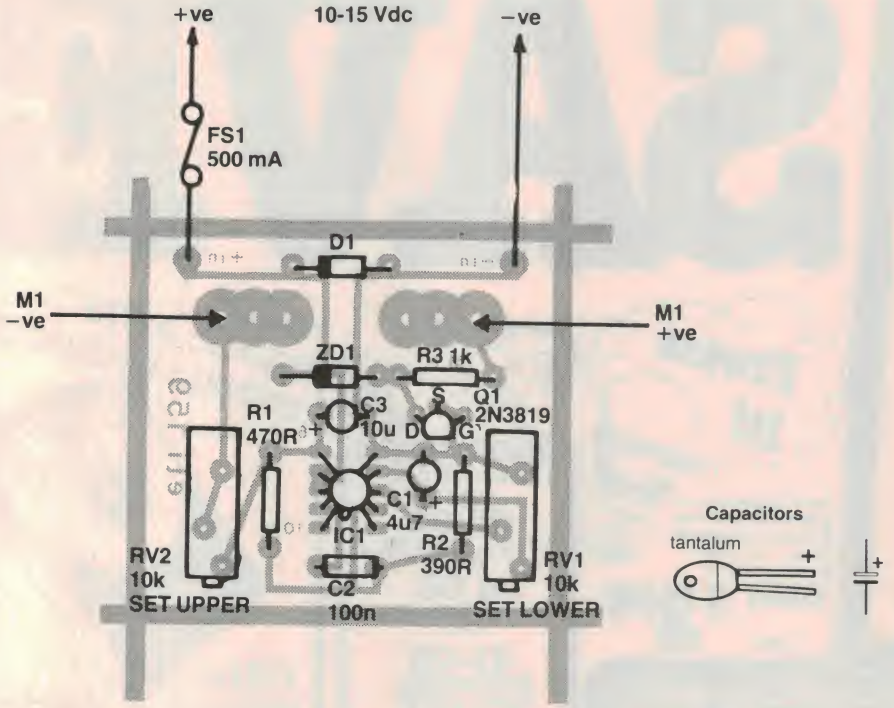
With NiCads, the electrolyte doesn't change during charge or discharge.

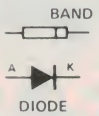
Fortunately, the terminal voltage is a good indicator of the state of charge or discharge. In general, the terminal voltage of a battery will be at a defined minimum when discharged (generally between 10 and 11 volts), and rise to a defined maximum when fully charged (generally around 15 volts). Under load, the terminal voltage will vary between these limits, depending on the battery's condition.

Hence a voltmeter having a scale 'spread' to read between these two extremes is a very good and useful indicator of battery condition. It's a lot less messy and more convenient than wielding a hydrometer to measure specific gravity of the electrolyte!

The charge and discharge characteristics of typical lead-acid and sealed NiCad batteries are given in the accompanying figures.

10-15 V meter





PARTS LIST — ETI 159

Resistors ..... all ½W, 2% metal film
- R1 ..... 470R
- R2 ..... 390R
- R3 ..... 1k
- RV1, RV2 ..... 10k cermet multiturn horizontal trimpot

Capacitors
- C1 ..... 4u7/10 V tant.
- C2 ..... 100n greencap or ceramic
- C3 ..... 10u/10 V tant.

Semiconductors
- IC1 ..... LM723CH
- ZD1 ..... 4V7, 400 mW or 1 W zener
- Q1 ..... 2N3819
- D1 ..... 1N4002 or similar

Miscellaneous
- M1 ..... 1 mA meter (see text)
- FS1 ..... 500 mA fuse and in-line fuse holder

ETI-159 pc board; meter scale to suit meter; colour-coded (red & black) 'figure-8' cable, etc.

Price estimate

We estimate the cost of purchasing all the components for this project will be in the range:

$20—$23

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project, such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel supplied (if used), etc — whether bought as separate components or made up as a kit.

The pc board and meter scale artwork are on page 147.

Construction

Mechanical construction of this project has been arranged so that the pc board can be accommodated on the rear of any of the commonly available moving coil meter movements. We chose a meter with a 55 mm wide scale (overall panel width, 82mm). A meter movement with a large scale is an advantage as it is considerably easier, and more accurate, to read than meters with a smaller scale. It also pays to buy a 'Class 2' meter (2% fsd accuracy) for best accuracy.

Having chosen your meter, drill out the pc board to suit the meter terminal spacing first. The components may then be assembled to the board in any particular order that suits you. Watch the orientation of the 723, ZD1, the FET and particularly D1. The latter is an 'idiot diode'. That is, if you have a lapse of concentration or forethought and connect your project backwards across a battery, the fuse will blow and not the project. Fuses are generally found to be cheaper than this project!

Seat all the components right down on the pc board as the board may be positioned on the rear of the meter with the components facing the meter. The size of C2 may give you a little trouble. Greencaps are generally too large and therefore unsuitable. We used a 'Monobloc' type capacitor — as commonly used on computer pc boards as bypasses. Alternatively, a 100n tantalum capacitor (+ve to pin 2 of IC1) may be used. The actual value or type of capacitor is not all that critical.

We have used multiturn trimpots for RV1 and RV2 as they make the setting up a whole lot easier.

Note that the fuse (to protect the project) is inserted in an in-line holder in the external connecting leads. For these leads we used 'automotive' figure-8 cable, colour-coded red (for +ve) and black (for −ve).

Calibration

For this you will need a variable power supply covering 10 to 15 volts and a digital multimeter (borrow one for the occasion).

First set the 10 V point. Connect the digital multimeter across the power supply output and adjust the power supply to obtain 10.00 volts. Set the mechanical zero on the meter movement to zero the meter's pointer. Connect the unit to the power supply output and adjust RV1 to zero the meter needle.

Next, set the power supply to obtain 15.00 V. Now adjust RV2 so that the meter needle sits on 15 V (full scale). Check the meter reading with the power supply output set at various voltages across the range. We were able to obtain readings across the full scale within ± half a scale reading (±50 mV). With a Class 2 meter the worst error may be about ± one scale division.

When set up, our unit drew 12.5 mA maximum current drain, which is probably typical, but current drain may be around 20 mA or so maximum. Note that, when the input voltage is below 10 V, the meter needle will move in the reverse direction. ●

Make your hobby into a career!

Retail Electronics Trainee Managers

We need managers for the new stores we're opening right around Australia - and overseas. What better way to prepare for this than by training in a current Dick Smith Store. If you're between 18 and 30, have a hobby background in electronics and retail experience, give us a call. We'll probably place you in a store close to home (we have 25 stores - in most states).

Contact Mr Bob Johnson, Retail Supervisor (02) 888 3200 or ask your local store manager.

SERVICE TECHNICIANS:

Our North Ryde (NSW) service centre needs technical experts in all categories: audio, RF digital . . . the opportunities for promotion are very, very good for the right people (our current National Service Manager started 'on the bench' just a few years ago!) You'll be working in air-conditioned premises, with the latest in service aids. The pace is hectic - so we want people who don't need continual supervision.

Contact Gary Crapp, National Service Manager (02) 888 3200.

SAVE

Freeze It!

Instantly freezes components down to minus 50 degrees Centigrade! Cools components whilst soldering.

ONLY $2.95

N-1056

STOCK UP NOW!

ON LOW PRICED SOLDER

1.25mm (18g) 200g
N-1619
$4.95

0.71mm (22g) 200g
N-1623
$4.95

1.25mm (18g) hobby pk
N-1638
$1.08
'10% OFF'

0.71mm (22g) hobby pk
N-1636
$1.08
10% OFF

WIDE RANGE AF/RF SIGNAL GENERATOR

Q-1305

18Hz-200MHz RANGE

This wide band signal generator is ideal for the service technician, developmental laboratory, the amateur & the hobbyist. Solid state, compact & light-weight, it gives you a selectable sinewave or squarewave at any frequency from 18Hz-200MHz.

ONLY $155

SOLAR CELL

SPECS: Output level - 450mV @ 95mA (43mW per cell.) **$2.95**

Get your free energy now! Great for the experimenter, or hobbyist.

Z-4835

WATCH THIS SPACE

Did you miss out on our BELOW COST SPECIAL LAST MONTH: PLASTIC PARTS CASE H-2590.

WAS: $3.60 NOW: $1.60 SAVE: $2.00

SAVE UP TO 50%

DICK SLASHES THE PRICE OF GENUINE 'CANNON' PLUGS!

	TYPE	CAT No	WAS	NOW
CANNON AUDIO PLUGS	3 pin line socket	P-1620	$3.75	$3.10
	3 pin panel plug	P-1622	$3.75	$2.20
	3 pin line plug	P-1624	$3.95	$2.15
	3 pin panel socket	P-1626	$4.20	$3.40
CANNON COMPUTER CONNECTORS	25 pin 'D' type plug	P-2690	$5.90	$5.05
	25 pin 'D' type socket	P-2691	$7.95	$6.20

YOU REAP THE BENEFIT!

DESOLDERING BRAID

SAVE 25%

Specially treated copper braid that is used to remove solder from PC boards.

ONLY $2
N-1682

TANDY'S PRICE $2.69

27MHz TX/RX TESTER

Get the most out of your 27MHz transceiver. Just look at what it'll do: measure pwr output up to 5W, VSWR from 1:1 to 1:3, Modulation percentage 0-100%, Relative field strenght, Check crystal activity, Generate 1000Hz for audio testing, plus much, much, more. Unit is supplied with instructions, leads & telescopic antenna.

ONLY $49.50

Q-1380

The low cost answer for 'phone answering

Call Jotter

Y-2100

ONLY $99.50

This exciting machine connects to your telephone and the power supply (supplied) then plugs into the AC mains. You can use pre-recorded tapes supplied, or make your own messages. Tape handles up to 30 calls.

NOTE: Not Telecom approved.

DICK SMITH'S PRO QUALITY MULTIMETER

CHECKS TRANSISTORS & MEASURES CAPACITANCE TOO!

100k OHMS PER VOLT

This is virtually a complete test bench in one small package . . . the features are too numerous to mention in such a small space. If you want a multimeter that will do just about everything . . . this is it! Complete with batteries, leads & instruction manual. Come in & check it out now!

Q-1140

AND ONLY **$74.50**

TRANSISTOR CHECKER/MULTIMETER

This multimeter is similar to the Q-1140 above right, but there are a few differences: If you don't need to measure capacitors (for instance you might have an AC Bridge), you can save heaps. Otherwise, everything else is pretty much the same. A bargain at this price!

ONLY $59.00

Q-1136

PROTECT YOUR METER

This handy meter carry case keeps your leads & instructions tidy, also gives you room to store notes, circuits etc

ONLY $14.95

Q-1137

WAS $17.50 2 YEARS AGO!!

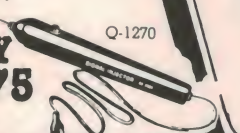
OPEN LATE NIGHTS FOR CHRISTMAS

Yes, all our stores will be open on normal late shopping nights until Christmas.

with DICK'S DIRECT IMPORT PRICES

NEW ECONOMY SIG. INJECTOR

This handy little instrument is a must for around the shack. Great for the hobbyist, amateur or technician.

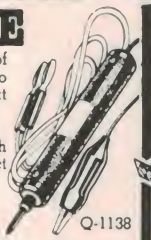


Q-1270

ONLY $6.75

MULTIMETER RF PROBE

Extend the useful range of your multimeter way up into the RF region with this neat probe. Freq. response is 150kHz to 30MHz (ref. 500 kHz). Comes equipped with 4mm banana plugs for direct multimeter connection.



Q-1138

$17.95

RESISTANCE SUBSTITUTION WHEEL

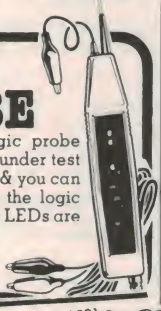
Easy to read value selection that enables you to select values from 5 ohms to 1M ohm in 36 steps using most common divisions. Complete with leads & clips.

Q-1410

$7.95

LOGIC PROBE

This outstsanding logic probe hooks onto the circuit under test for its power (5V DC), & you can tell at a glance what the logic level is by which of the LEDs are glowing.



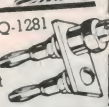
$28.50

Q-1272

CRO-BNC ADAPTOR $9.90

Q-1281

Converts the 'banana' socket terminals to a BNC type.



Value heatsinks

This TO-3 heatsink gives the greatest possible heat dissipation in the smallest possible space. Thermal rating of approx. 5°C/W. 50mm square by 25mm high. **10 OR MORE $1.20ea.**

ONLY $1.35ea.

H-3400

H-3401

Universal hole pattern allows the mounting of almost all 'power' semiconductors. Has ribbed walls for max. efficiency. **10 OR MORE 90ea.**

ONLY $1.00ea.

H-3470

Flag mounting type with fins top & bottom. Available drilled or undrilled to accept two power transistors of most types. **10 OR MORE $3.20 EA.**

ONLY $3.75ea.

H-3422

With its thick base & radial fan design, this heatsink is able to dissipate huge amounts of heat. Thermal resistance, mounting surface to ambient -1°C/W (2.0ft/sec air velocity). Mounting surface temp. rise above ambient 60°C @ 30W heat dissipation level. **10 OR MORE $3.50ea.**

ONLY $3.75ea.

GREAT LED DEAL!

FLASHING LEDS $1.50 EACH... OR TWO FOR $1.00

Z-4000

SAVE ON MEMORY

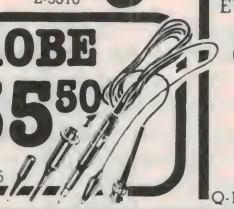
What a bargain price for fast 4116 dynamic RAMs! You won't bleat at our price

ONLY $3.95

Z-9310

100MHz x1/x10 CRO PROBE

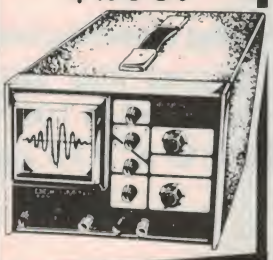
This incredibly versatile probe set, will suit virtually any CRO & give you all the features of a probe set you would pay $$$$ more for. Here's what you get: Basic probe with inbuilt x1/x10 switch, 1.5M of cable, complete with co-ax type BNC connector & wandering earth lead with aligator clip.



$35.50

Q-1245

LESS THAN $200!



OVER 1,500 SOLD!

QUALITY 6.5MHz 75mm CRO

This oscilloscope is ideal for the laboratory, the classroom, in field service, in bench service, in assembly centres and of course, in hobby applications. Solid state electronics ensures extremely low drift & fast warm-up. Check these features:

- Retrace blanking: gives a much clearer display.
- Lower threshold triggering: less ½ division at 5MHz.
- Sharper focus - especially at high frequencies.
- Fibreglass PCB.
- Colour coded input terminals.
- AND A USEABLE RESPONSE TO BEYOND 6.5MHz!

★★★★★★★★★★★

Plus ***FREE*** CRO-BNC adaptor with every purchaseof the Q-1280 oscilloscope.

★★★★★★★★★★★

... AN OSCILLOSCOPE EVERYONE CAN AFFORD!

and all for ONLY $199

Q-1280

MAJOR DICK SMITH RE-SELLERS

These re-sellers stock a large range of our products. However we cannot guarantee they will have all items in stock, or at the prices we advertise.

ATHERTON, QLD: Jue Sue's Radio Service
55 Main Street Phone 911 208

BENDIGO, VIC: Sumner Electronics
95 Mitchell Street Phone 431 977

BALLINA, NSW: A. Cummings & Co.
91-93 River Street. Phone 862 285

BLACKHEATH, NSW: Goodwin Electronics
123 Station Street Phone 878 379

BROKEN HILL, NSW: Crystal TV Rentals
66 Crystal Street. Phone 6897

CAIRNS, QLD: Thompson Instrument Services
79-81 McLeod Street. Phone 512 404

COFFS HARBOUR, NSW: Coffs Harbour Elect
3 Coffs Harbour Plaze, Park Ave. Phone 525 684

DARWIN, NT: Kent Electronics
42 Stuart Highway. Phone 814 749

DUBBO, NSW: Dubbo Electronic Services
157 Brisbane Street. Phone 829 355

EAST MAITLAND, NSW: East Maitland Elect
Cnr. Lews & High Streets. Phone 337 327

GERALDTON, WA: KB Electronics & Marine
361 Main Terrace. Phone 212 176

GOSFORD, NSW: Tomorrow's Electronics
68 William Street. Phone 247 246

HOBART, TAS: Aero Electronics
123a Bathurst Street. Phone 348 232

KINGSTON, TAS: Kingston Electronics
Channel Court Phone 296 802

LAUNCESTON, TAS: Advanced Electronics
5a The Quadrant. Phone 317 075

LISMORE, NSW: Decro Electric
Magellan Street & Bruxner Hwy Phone 214 137

MACKAY, QLD: Stevens Electronics
42 Victoria Street. Phone 511 723

MARYBORDUGH, QLD: Keller Electronics
218 Adelaide Street. Phone 214 559

MORUYA, NSW: Coastal Electronics
43 Vulcan Street. 742 545

MT GAMBIER, SA: Hutchesson's Comm
5 Elizebeth Street. Phone 256 404

MUSWELLBROOK, NSW: Silicon Chip Elect
Suite 3, 98 Bridge Street. Phone 43 1096

NAMBOUR, QLD: Nambour Electronic Shop
Shop 4, Lowen House, Ann St. Phone 411 604

NEWCASTLE, NSW: Elektron 2000
181 Wharf Road. Phone 262 644

ORANGE NSW: M&W Electronics
173 Summer Street. Phone 626 491

PENRITH, NSW: Acorn Electronics
Shop 12 541 High St (Phone not yet connected)

PT MACQUARIE NSW: Hall of Electronics
113 Horton Street. Phone: (not yet connected).

ROCKHAMPTON, QLD: Purely Electronics
15 East Street. Phone 21 058

SOUTHPORT, QLD: Amateur's Paradise
121 Nerang Street. Phone 322 644

TAMWORTH, NSW: Sound Components
111 Bridge Street. Phone 654 363

TOOWOOMBA, QLD: Hunts Electronics
18 Neil Street Phone 329 677

TOWNSVILLE, QLD: Tropical TV
49 Fulham Road, Vincent Village. Phone 791 421

TRARALGON, VIC: Power'n'Sound
147 Argyle Street Phone 743 638

WAGGA, NSW: Wagga Wholesale Elect
82 Forsyth Street

WODONGA, VIC: A & M Electronics
78a High Street. Phone 244 589

WHYALLA, SA: Mellor Enterprises
Shop 2, Forsythe Street. Phone 454 764

Dear Customer:

Quite often, the products we advertise are so popular they run out within a few days. Or, unforseen circumstances might hold up goods so that advertised lines are not in the store by the time the advert appears. Please don't blame the store manager or staff, they cannot solve a dock strike on the other side of the world, or even locate a shipment that has gone astray. What we are trying to say is that, if you are about to drive across town to pick up a particular line at a Dick Smith Store, why not give the store a ring first (addresses/phone numbers below) just in case! Thanks.

Dick Smith & Staff.

P&P. CHARGES

Order Value	Charges
$5-$9.99	$1.20
$10-$24.99	$2.20
$25-$49.99	$3.30
$50-$99.99	$4.40
$100 or more	$6.00

These charges for goods sent by post in Aust. only - Not airmail, overseas or road freight.

DICK SMITH Electronics

SHOPS OPEN 9AM to 5.30PM (Saturday: 9am till 12 noon) BRISBANE: Half hour earlier. ANY TERMS OFFERED ARE TO APPROVED APPLICANTS ONLY

NSW	145 Parramatta Rd	AUBURN	648 0558
	T55 Terrace Level	BANKSTOWN SQ	
	613 Princes Hwy	BLAKEHURST	546 7744
	818 George St	BROADWAY	211 3777
	531 Pittwater Rd	BROOKVALE	93 0441
	147 Hume Hwy	CHULLORA	642 8922
	162 Pacific Hwy	GORE HILL	439 5311
	396 Lane Cove Rd	NORTH RYDE	888 3200
	30 Grose St	PARRAMATTA	683 1133
	125 York St	SYDNEY	290 3377
	173 Maitland Rd	TIGHES HILL	61 1896
	263 Keira St	WOLLONGONG	28 3800
ACT	96 Gladstone St	FYSHWICK	80 4944
QLD	166 Logan Rd	BURANDA	391 6233
	842 Gympie Rd	CHERMSIDE	59 6255
SA	60 Wright St	ADELAIDE	212 1962
	Cnr Main Sth Rd & Flagstaff Rd	DARLINGTON	298 8977
	435 Main North Rd	ENFIELD	260 6088
VIC	399 Lonsdale St	MELBOURNE	67 9834
	260 Sydney Rd	COBURG	383 4455
	656 Bridge Rd	RICHMOND	428 1614
	Cnr Dandenong & Springvale Rds	SPRINGVALE	547 0522
WA	Cnr Wharf St & Albany Hwy	CANNINGTON	451 8666
	414 William St	PERTH	328 6944

Mail Order Centre:
PO Box 321 North Ryde 2113 Phone (02) 888 3200

DSE 093RB

Lab Notes

Using the LM 396 10A adjustable voltage regulator

Barry Davis

A new voltage regulator using a revolutionary IC fabrication technique has been introduced into the marketplace by National Semiconductor. It is the LM 196/396, a 10 ampere adjustable voltage regulator in a TO-3 package.

THIS NEW regulator has *all the protection features* that hobbyists have taken for granted in the lower power LM117/317 family. It is immune to blowout from excessive output current and all devices are 'burned-in' to guarantee the correct operation of the protection circuits under overload conditions.

The output voltage is adjustable over the range of 1.25 to 15 volts. *The maximum input-output voltage differential* (V_{in} - V_{out}) *is 20 volts*, and higher output voltages are possible providing that this parameter is not exceeded. A full load current of 10 amperes is available at all output voltages; however, the maximum power dissipation (70 watts) and the junction temperature must be watched closely. At a load current of 10 amperes, the maximum permissible V_{in} - V_{out} differential is 7 volts. Under these conditions the power dissipated is —

V_{in} - V_{out} x I_{max}

$= 7 \times 10 = 70$ watts.

The features of the regulator are:

- 10 A guaranteed output current.
- 70 W maximum power dissipation.
- Adjustable output from 1.25 to 15 V.
- 100% burn-in thermal limit.
- Internal current power limiting.
- Input-output voltage differential is 20 V maximum.
- Dropout voltage is approximately 2.1 V.
- TO-3 Package.

The current limit and maximum power dissipation characteristics are shown in Figure 1a and 1b respectively.

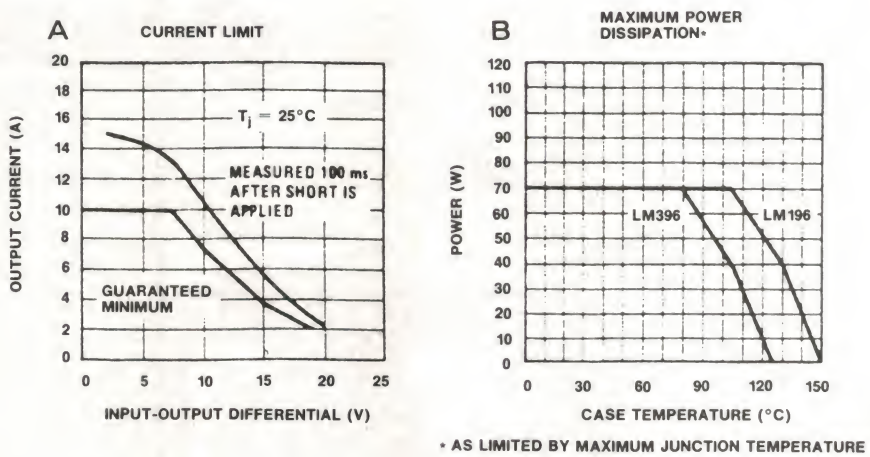


Figure 1. **Current limit and power dissipation**

Application precautions

1. Heatsinking

The major limitation in the output current capability of the regulator is heatsinking. The regulator has extremely high power dissipation, 70 watts continuously, providing that the maximum junction temperature limit is not exceeded. These limits are:

LM 196 -55°C to +150°C

LM 396 0°C to +125°C

Careful attention must be paid to *all* junction thermal resistances. A good heat-conductive paste *must* be used when mounting the regulator on the heatsink. The regulator must also be bolted down nice and tight. To ensure

ABOUT THE AUTHOR

Barry Davis is a lecturer with the Telecommunications Division of the Royal Melbourne Institute of Technology, engaged in teaching full-time technician students. He has worked in all facets of the electronics industry and is the author of a number of radio and television correspondence courses on fundamentals and servicing for Stotts.

Barry Davis is also the author of a text book called 'Understanding dc power supplies', published by Prentice-Hall earlier this year. This book mentions the development of National Semiconductor's 'Moose-process' LM196/396 regulator which very recently became available — hence this article.

the selection of the correct heatsink, the procedure is as follows.

Calculate the *worst case continuous average power dissipation* in the regulator from the formula:

$P = (V_{in} - V_{out}) \times I_{out}$.

The voltage/current characteristics of the unregulated input must be accurate. A small change in input voltage can result in a large increase in the power dissipated by the regulator. For example, normal operating conditions are:

$V_{out} = 10$ V
$V_{in} = 14$ V
$I_{out} = 10$ A
$P = (14 - 10) \times 10$
$= 40$ watts.

If the input voltage increases by 10% to 15.4 volts:

$P = (15.4 - 10) \times 10$
$= 54$ watts

— an increase in power dissipation of 35%.

Therefore, the power supply circuit up to the regulator input (i.e: transformer, rectifier diodes, filter capacitor) plays an important role in the successful operation of the regulator itself. It should be built and tested to determine its average dc output voltage under full load with maximum input voltage. This circuit is shown in Figure 2.

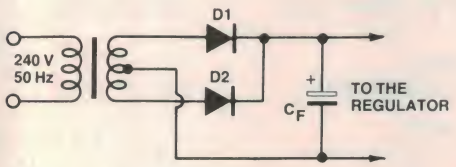


Figure 2. **Circuit prior to the regulator.**

The choice of C_F is also very important. At *high* current levels the capacitor ripple current (RMS) is two to three times the dc output current. If the capacitor has an equivalent series resistance (ESR) of 0.05 ohms, this can cause internal power dissipation (I^2R) of 20 to 45 watts at an output current of 10 amperes.

The life of the capacitor 'derates' with increase in operating temperature, and the choice of a small-value capacitor is asking for trouble (about 2000 μF is used for the LM 317 circuit). A value of some *2000 μF per ampere of load current* is the minimum recommended value. Large values of capacitor will have longer life and will also reduce the ripple

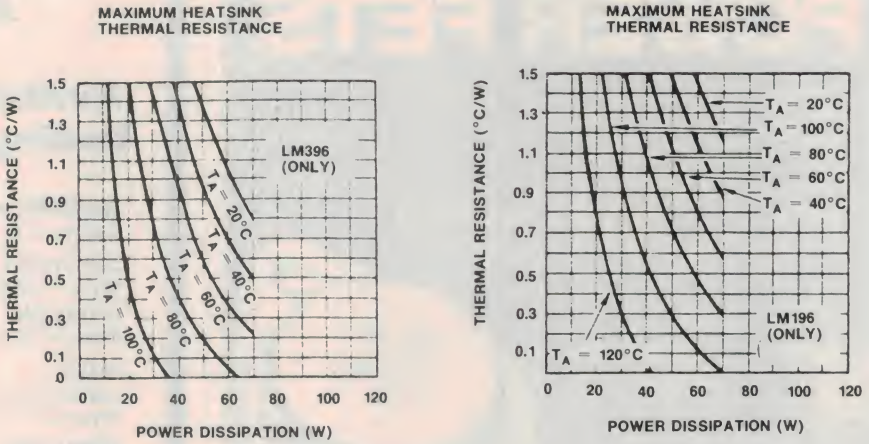


Figure 3. **Heatsink thermal resistance graphs (T_A = Ambient temperature)**

level. This allows a lower dc input voltage to the regulator, which will result in savings in transformer and heatsink costs.

A further idea is to place several capacitors in parallel. This increases the capacitance, reduces the net series resistance and increases the heat dissipating area (i.e: shares it among the capacitors). Once the circuit in Figure 2 has been finalised and the average dc output voltage determined, the thermal resistance of the heatsink can be determined from the graphs in Figure 3, in degrees centigrade per watt (°C/W).

For conservative heatsinking it is recommended that you choose T_A to be 35°C higher than anticipated.

The heatsink resistance generally falls into the range of 0.2°C/W - 1.5°C/W at a $T_A = 60$°C. These are *large* heatsinks such as the Philips 45D6CB, 55D6CB, and the large Minifin. These must be mounted for best convection cooling and could also be cooled by a fan.

2. Transformers

Correct transformer ratings are extremely important in high current supplies. If the secondary voltage is too high, power will be wasted and cause unnecessary power dissipation in the regulator. However, if the secondary voltage is too low it may cause loss of regulation if the input voltage (i.e: mains) fluctuates excessively.

The following formula can be used to calculate the secondary voltage required using the circuit in Figure 2 (full wave centre tap).

$$V_{(RMS)} = \frac{V_{out} + V_{reg} + V_{Rect} + V_{Ripple}}{\sqrt{2}} \times \frac{V_{Nom}}{V_{Low}} \times (1.1) \quad (1)$$

Where:

1.1 is the factor accounting for load regulation of the transformer.

V_{out} = dc regulated output voltage.

V_{Reg} = Minimum V_{in} - V_{out}.

V_{Rect} = Voltage drop (forward) across the diode at $3 \times I_{out}$.

V_{Ripple} = Peak capacitor ripple voltage (½ p-p).

i.e: $\frac{(5.3 \times 10^{-3})\ I_{out}}{2C}$

C is the capacitor value in farads.

V_{Nom} = Normal ac input (RMS).

V_{Low} = Minimum ac input (RMS).

The current rating required can be calculated from the formula:

$$I_{RMS} = I_{out} \times 1.2 \quad (2)$$

Where I_{out} = dc output current.

Transposing formula (2) we can calculate the value of filter capacitor required:

$$C = \frac{(5.3 \times 10^{-3})\ I_{out}}{2 \times V_{Ripple}} \quad (3)$$

The best way to appreciate these formulas in use is to calculate the values required for a power supply circuit. If we design a good mobile radio power supply, 13.8 volts at 10 amperes: ▶

The ZX PRINTER — designed for use with ZX81 and ZX80 with8K BASIC ROM. Alpha-numerics! Graphics!

$250 COMPLETE

sinclair ZX81

PERSONAL COMPUTER

sinclair COMPLETE WITH MAINS ADAPTOR, LEADS, ONLY $250

16K-BYTE RAM PACK $150

Higher specification, lower price — how's it done?

Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

The ZX81 comes complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

New, improved specification

- Z80 a microprocessor — new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function — useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer (not available yet — but coming soon)!
- Advanced 4-chip design, microprocessor, ROM, RAM, plus master chip — unique, custom-built chip replacing 18 ZX80 chips.

ZX Software Cassettes

Send for free catalogue of Games, Business, Educational, Junior Educationa. Encl. S.A.E.

FREE NEW BASIC ZX81 MANUAL

If you own a Sinclair ZX80 . . .

The new 8K BASIC ROM used in the Sinclair ZX81 is available to ZX80 owners as a drop-in replacement chip. (Complete with new keyboard template and operating manual.)

With the exception of animated graphics, all the advanced features of the ZX81 are now available on your ZX80 — including the ability to drive the Sinclair ZX Printer.

ORDER FORM — SINCLAIR EQUIPMENT (AUSTRALASIA) P/L

86-88 Nicholson Street, Abbottsford, Victoria, 3067. Telephone: 419 3033.

QUANTITY	ITEM	ITEM PRICE	TOTAL
	Ready assembled ZX81 Sinclair Personal Computer including mains adaptor, leads, BASIC manual	$250	
	16K-BYTE RAM pack	$150	
	8K-ROM (only required for ZX80)	$ 75	
	ZX Printer (to be announced)		

Total _____

I enclose cheque/Bankcard/Diners/Amex ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Name _____

Address _____ Postcode _____

Signature _____

ET1

Lab Notes

V_{out} = 13.8 V
I_{out} = 10 A
Assume V_{Reg} = 2.2 V, V_{Rect} = 1.2 V
V_{Ripple} = 2 V p-p, V_{Nom} = 240 V
V_{Low} = 220 V
Using formula (1)

$$V_{(RMS)} = \left(\frac{13.8 + 2.2 + 1.2 + 1}{\sqrt{2}}\right)\left(\frac{240}{220}\right)1.1$$

$$= \frac{18.2}{\sqrt{2}} \times 1.09 \times 1.1$$

$$= 12.869 \times 1.09 \times 1.1$$

$$= \underline{15.4 \text{ volts (RMS)}}$$

Using formula (2)

$$I_{(RMS)} = 10 \times 1.2$$

= 12 amperes (RMS)

The transformer must therefore be 240: 30 CT at 12 amperes. The centre tap (CT) will provide 15 volts secondary voltage for each diode.

The size of the filter capacitor required can be calculated using formula (3)

$$C = \frac{(5.3 \times 10^{-3})\ 10}{2 \times 1}$$

$$= 26500\ \mu F$$

The transformer, rectifier and filter circuit is now shown in Figure 4.

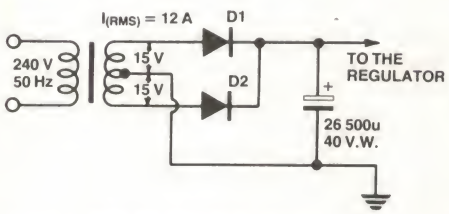


Figure 4. **Rectifier and filter circuit**

3. Diodes

The diodes used in the circuit must have a high dc current rating. The capacitor input filter draws high peak current pulses that are considerably higher than the average dc current. With a 10 amperes supply the average current is 5 amperes. The current pulse's duration and amplitude result in a long-term diode heating of approximately 10 amperes dc. Therefore the diodes should have a rating of at least 10-15 amperes. Also, the power supply may have to survive a short circuit and average current could rise to 15 amperes (see Figure 1a).

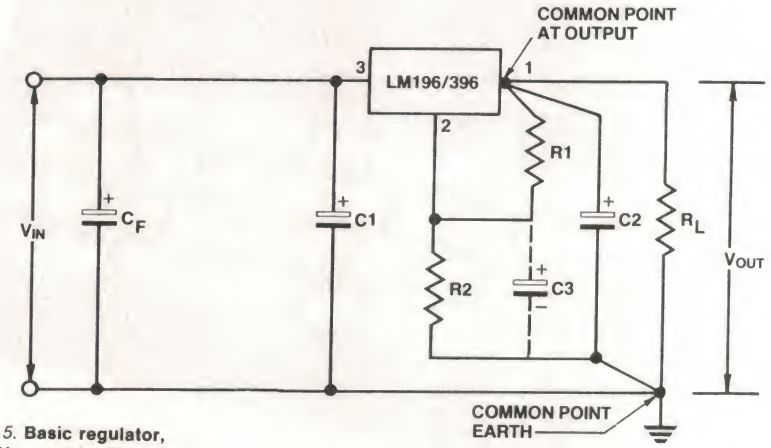


Figure 5. **Basic regulator, $V_{out} = 1.25\ \frac{(R1 + R2)}{R1}$**

Another important factor in the choice of diode is the surge current at switch on. The peak *surge current* is about *10-20 times the dc output current* (i.e: 100-200 A for a 10 A supply). (Note: smaller transformers and filter capacitors may be used in lower current supplies. This will reduce the surge current; unless you are sure of the worst case surges, do not economise on diodes.)

Stud-mounted diodes in a DO-4 or DO-5 package are recommended, such as IR 12F10B, IN3209 or 16F10 silicon rectifiers. Remember to choose the correct PIV for the type of transformer in use (PIV = $\sqrt{2}\ V_{Secondary}$).

4. Wiring

High load currents produce higher than normal voltage drops across the resistance of the wiring. It is suggested that 16-18 gauge wire is used for input and output connections, and the *length is kept to a minimum.*

The two resistors used to set the output voltage level are connected:

1. directly to a common point earth and
2. directly to the output of the regulator as shown in Figure 5.

Components in Figure 5.

C_F = Main filter capacitor 26 500 μF.

C1 = 4μ7 tantalum. It is only necessary if the main filter capacitor is more than 150 mm away from the regulator. Connecting wire is 18 gauge or larger.

C2 = 4μ7 tantalum. It is not absolutely necessary, but is recommended to maintain low output impedance at high frequencies.

C3 = 25 μF. Improves ripple rejection, output impedance, and noise. (Capacitor C2 should be close to the regulator if C3 is used).

R1 = 120 ohms. It should be a wirewound or metal film resistor, tolerance 1% or better.

R2 = calculated to set V_{out}; the same type of resistor as R1.

The value of R2 can be calculated from the formula:

$$R_2 = \left(\frac{V_{out}}{1.25}\right) \times R1 - R1$$

Example:

V_{out} = 13.8 V
R1 = 120 ohms

$$R2 = \left(\frac{13.8}{1.25}\right) \times 120 - 120$$

$$= (11.04 \times 120) - 120$$

$$= 1324.8 - 120$$

$$= 1204.8 \text{ ohms.}$$

As stated earlier, the package is a TO-3 and the connections are shown in Figure 6. ▶

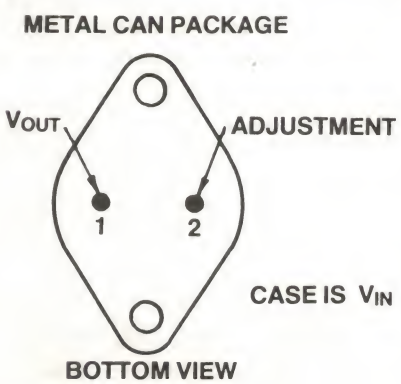


Figure 6. **Connection diagram**

ALL ELECTRONIC COMPONENTS

That's our name . . . that's our game!!!

MAJOR STOCKISTS OF ALL GENERAL RADIO AND ELECTRONIC COMPONENTS

"WE ARE NOW OFFICIAL INTERSIL DISTRIBUTORS"

Check our low prices on these fabulous products by "INTERSIL". O.E.M.'s & Resellers enquiries welcome.

ICM 7211	$11.84	ICM 7215EV/Kit (Stopwatch Kit)	$36.56	ICL 8038 CC	$6.70
ICM 7226B	$35.25	ICL 7650 CPD	$5.85	ICL 8069 CC SQ	$3.45
ICM 7556 IPD	$ 2.20	ICL 7660 CPA	$4.28	Product & Data Book etc. etc.	$14.10
ICM 7555 IPA	$1.70				

Prices include Sales Tax. Allow $2.00 Pack and Certified Post.

ETI AND EA KITSET SPECIALISTS (LARGEST RANGE IN AUSTRALIA) — TOP QUALITY, LOW PRICES

LEARN WHILE YOU BUILD

STEREO UNITS
S1 ETI 484 Compressor Expander
S2 ETI 482 50 watt per channel Amplifier
S3 ETI 482A Preamp Board
S4 ETI 482B Tone Control Board
S5 ETI 485 Graphic Equalizer
S6 ETI 480 50 watt Amplifier less H/S & bracket
S7 ETI 480 100 watt Amplifier less H/S & bracket
S8 ETI 480 Power Supply for above
S9 ETI 443 Expander Compressor
S10 ETI 444 Five watt stereo
S11 ETI 458 Audio Level Meter
S12 ETI 438 Audio Level Meter
S13 ETI 440 25 watt Stereo Amplifier including metalwork
S17 ETI 422 50 watt per channel Amplifier*
S18 ETI 426 Rumble Filter
S19 ETI 429 Simple Stereo Amplifier
S21 ETI 417 Over LED Distortion Monitor
S24 ETI 427 Graphic Equalizer*
S28 E.A. Playmaster 136 13 watt
S30 E.A. Playmaster 143 12.5 watt
S31 EA Musi Colour 4 1000 w/ch
S33 E.A. Musicolour III 1000 w/ch
S34 E.A. Stereo Dynamic Noise Filter
S35 ETI 470 60 watt audio amplifier module
S36 ETI 4000 Series 60 watt stereo amplifier
S37 ETI 451 Hum Filter for Hi-Fi systems
S38 E.A. Stereo Infrared Remote Switch
S39 ETI 455 Stereo Loudspeaker Protector
S40 E.A. Super-Bass Filter Less Power Pack
S42 E.A. Stylus Timer
S43 ETI Series 3000 Amplifier 25w/ch
S44 ETI 477 Mosfet power amp module inc. brackets
S45 ETI 457 Scratch/Rumble Filter

PRE-AMPLIFIERS AND MIXERS
P1 ETI 445 Stereo Pre-Amplifier
P2 ETI 449 Balance Mic Pre-Amplifier
P5 ETI 414 Master Mixer 8 channel
P6 ETI 419 Mixer Pre-amplifier — 4 ch. Mixer Pre-amplifier — 2 ch.
P7 ETI 401 F.E.T. 4 Input Mixer
P10 E.A. Playmaster 145 Mixer
P11 ETI 446 Audio Limiter
P12 ETI 471 High Performance Stereo Pre-amplifier
P13 ETI 477 Moving Coil Cartridge Pre-Amp
P14 ETI 474 High to low Impedence Interface
P15 ETI 467 4 Input Guitar/Mic. Pre-amp Suits
P16 ETI 5000 Pre Amp.

TUNERS
T1 ETI 062 A.M. Tuner
T2 ETI 740 F.M. Tuner*
*Wooden cabinet not included

GUITAR UNITS
G1 ETI 447 Audio Phaser
G2 ETI 413 2 x 100 watt Bridge Amplifier
G5 ETI 413 100 watt Guitar Amplifier
G6 ETI 410 A.D.U. for your Guitar
G14 ETI 452 Guitar Practice Amplifier
G15 ETI 466 300 watt Amp module — less H/S & Transformer
G16 ETI 454 Fuzz-Sustain less foot switch

AUDIO TEST UNITS
AT1 ETI 441 Audio Noise Generator
AT2 ETI 128 Audio Millivolt Meter
AT4 ETI 102 Audio Signal Generator
AT7 ETI 137 Audio Oscillator
AT8 ETI 138 Audio Power Meter

Also Hobby Electronic Projects.

POWER SUPPLIES
PS1 ETI 132 Experimenters Power Supply
PS2 ETI 581 Dual Power Supply (High Powered Version)
PS3 ETI 712 CB Power Supply
PS4 ETI 131 Power Supply
PS6 ETI 105 Laboratory Power Supply
PS7 ETI 111 I/C Power Supply
PS9 E.A. 1976 Regulated Power Supply
PS10 E.A. Dual 30-2 0-30V at 2A or 0-60V at 2A or Dual Pos and Neg 30V at 2A
PS11 E.A. C.B. Power Supply
PS12 ETI 142 Power Supply 0-30 V 0-15 A (fully protected)
PS13 ETI 472 Power Supply
PS14 E.A. Power Supply for Dream 6800
PS15 ETI 577 Dual 12V supply
PS16 E.A. Power Saver

COMPUTER AND DIGITAL UNITS
C1 ETI 633 Video Synch Board*
C2 ETI 632M Part 1 Memory Board V.D.U.*
C3 ETI 632P Part 1 Power Supply V.D.U.*
C4 ETI 632A Part 2 Control Logic V.D.U.*
C5 ETI 632B Part 2 Control Logic V.D.U.*
C6 ETI 632C Part 2 Character Generator V.D.U.*
C8 ETI 632 U.A.R.T. Board*
C9 ETI 631-2 Keyboard Encoder*
C10 ETI 631 A/Sch. Keyboard (less keyboard)*
C11 ETI 660 Computer
C13 E.A. Cassette-Tape Interface
C14 ETI 638 Eprom Programmer
C15 ETI 637 Cuts Cassette Interface
C16 ETI 651 Binary to Hex Number Converter
C17 ETI 730 Getting Going On Radio Tele Type
C18 E.A. Dream 6800 Computer for Beginners less keyboard and cover
C19 ETI 731 R.T.T.Y. Modulator
C20 ETI 450A Bucket Brigade
C21 ETI 450B Mixer for above

TEST EQUIPMENT
TE2 ETI 133 Phase Meter
TE3 ETI 533C Digital Display
TE4 ETI 129 R.F. Signal Generator
TE5 ETI 130 Temperature Meter
TE6 ETI 706 Marker Generator
TE8 ETI 122 Logic Tester
TE9 ETI 124 Tone Burst Generator
TE10 ETI 123 C Mos Tester
TE11 ETI 116 Impedance Meter
TE12 ETI 533 Digital Display
TE13 ETI 117 Digital Voltmeter 1975 Display
TE14 ETI 117 Digital Voltmeter 1976 Display
TE15 ETI 704 Cross Hatch Dot Generator
TE16 ETI 120 Logic Probe
TE17 ETI 121 Logic Pulser
TE18 ETI 118 Digital Frequency Meter 1975 Display
TE19 ETI 118 Digital Frequency Meter 1976 Display
TE20 ETI 157 Crystal Marker
TE34 ETI 487 Real Time Audio Analyser
TE35 ETI 483 Sound Level Meter
TE36 ETI 489 Real Time Audio Analyser
TE37 ETI 717 Cross Hatch Generator
TE38 E.A. 3 Mhz Frequency Counter
TE41 E.A. Function Generator
TE42 E.A. Transistor Tester incl. BiPolar & F.E.T.S.
TE43 ETI 591 Up Down Pre-setable Counter
TE44 ETI 550 Digital Dial (less case) includes ETI 591
TE45 ETI 144 Expanded Scale R.M.S. Voltmeter
TE46 ETI 148 Versatile Logic Probe
TE47 ETI 724 Microwave Oven Leak Detector
TE48 ETI 150 Simple Analog Frequency Meter
TE49 ETI 151 Linear Scale Ohm Meter
TE50 ETI 152 Linear Scale Capacitance Meter
TE51 E.A. Digital Capacitance Meter
TE52 ETI 589 Digital Temp. Meter
TE53 E.A. T.V. C.R.O. Adaptor less Power Pack
TE54 E.A. XTAL Locked Pattern Generator
TE55 E.A. Decade Resistance Sub Box
TE56 E.A. Capacitance Sub Box
TE57 E.A. Decade Capacitance Sub Box
TE58 E.A. Tantalum Capacitance Sub Box
TE59 ETI 140 1 GHZ Frequency Meter/Timer
TE60 ETI 572 PH Meter
TE61 ETI 135 Panel Meter

WARNING SYSTEMS
WS1 ETI 583 Gas Alarm
WS3 ETI 528 Home Burglar Alarm
WS4 ETI 702 Radar Intruder Alarm
WS7 ETI 313 Car Alarm
WS12 ETI 582 House Alarm
WS14 E.A. 1976 Car Alarm
WS15 E.A. 10 Ghz Radar Alarm
WS16 E.A. Light Beam Relay
WS17 ETI 247 Soil Moisture Indicator

MODEL TRAIN UNITS
MT1 ETI 541 Model Train Control
MT6 E.A. 1978 Train Control

AUTOMOTIVE UNITS
A1 ETI 317 Rev. Monitor
A3 ETI 316 Transistor Assisted Ignition
A4 ETI 240 High Power Emergency Flasher
A6 ETI 312 Electronic Ignition System
A6 ETI 326 Expanded Scale Volt Meter
A14 E.A. Dwell Meter
A15 E.A. Variwiper
A16 E.A. Tacho for Tune-ups
A20 ETI 325 Auto Probe
A19 E.A. 1975 C.D.I. Capacitor Discharge Ignition
A22 ETI 318 Digital Car Tachometer (less Metalwork)
A23 ETI 319A Variwiper Mk. 2 (no dynamic braking)
A24 ETI 319B Variwiper Mk. 2 (for dynamic braking)
A25 ETI 555 Light Activated Tacho
A26 ETI 320 Battery Condition Indicator
A27 E.A. Transistor Assisted Ignition
A28 ETI 324 Twin Range Tacho less case
A29 ETI 328 LED Oil Temp Meter less V.D.O. probe

PHOTOGRAPHIC
PH1 ETI 586 Shutter Speed Timer
PH3 ETI 514B Sound Light Flash Trigger
PH4 ETI 532 Photo Timer
PH7 ETI 513 Tape Slide Synchronizer
PH10 ETI 540 Universal Timer
PH12 E.A. Sync-a-Slide
PH14 ETI 558 Mast Head Strobe
PH15 ETI 553 Tape Slide Synchronizer
PH16 E.A. Digital Photo Timer
PH17 ETI 594 Development Timer
PH18 ETI 568 Sound or light operated Flash Trigger inc. optional parts

RECEIVERS/TRANSMITTERS
R1 ETI 711 Remote Control Transmitter Switch
R2 ETI 711R Remote Control Receiver
R3 ETI 711D Remote Control Decoder
R4 ETI 711B Single Control
R5 ETI 711C Double Control
R6 ETI 711P Power Supply
R7 ETI 707A 144 Mhz Converter
R8 ETI 707B 52 Mhz Converter
R9 ETI 708 Active Antenna
R10 ETI 760 Modulator
R11 ETI 780 Novice Transmitter
R12 ETI 703 Antenna Matching Unit
R15 E.A. 110 Communications Receiver
R17 E.A. 130 Communications Receiver
R18 E.A. All Wave I/C 2
R20 E.A. Fremodyne 4 Complete Kit
R21 E.A. Fremodyne 4 RF Section
R31 E.A. 27 Mhz Pre-amp
R32 E.A. 10-30 Mhz Pre-amp
R33 ETI 718 Shortwave Radio
R34 ETI 490 Audio Compressor
R35 ETI 721 Aircraft Band Converter (less XTALS)
R36 ETI 726 6 or 10 metre Power Amp
R37 ETI 475 Wide Band A.M. Tuner
R38 ETI 585 Ultrasonic Switch

VOLTAGE/CURRENT CONTROLS
V1 ETI 481 12 volt to - 40V D.C. 100 watt Inverter
V2 ETI 525 Drill Speed Controller
V6 E.A. 1976 Speed Control
V7 ETI 592 Light Show Controller (3 ch.) (1000 w/ch)
V8 E.A. Inverter 12V D/C input 230V 50hz 300VA output
V9 ETI 593 Colour Sequencer (for use with ETI 592)

MISCELLANEOUS KITS
M1 ETI 604 Accentuated Beat Metronome
M2 ETI 546 G.S.R. Monitor (less probes)
M3 ETI 549 Induction Balance Metal Detector includes wire for search head
M4 ETI 547 Telephone Bell Extender
M5 ETI 602 Mini Organ (less case)
M6 ETI 544 Heart Rate Monitor
M7 ETI 044 Two Tone Doorbell
M8 ETI 043 Heads and Tails
M9 ETI 068 L.E.D. Dice Circuit
M10 ETI 539 Touch Switch
M22 ETI 256 Humidity Sensor
M23 E.A. Electronic Roulette Wheel
M25 E.A. Digital Metronome
M26 E.A. Voice Operated Relay
M29 E.A. Sound Effects Generator
M30 ETI 551 Light Chaser 3 channel 1000 watt/ch
M32 E.A. Remote TV Headphone
M34 ETI 650 STAC Timer
M36 ETI 557 Reaction Timer
M37 ETI 249 Combination lock (less lock)
M38 ETI 814 Dinky Die
M39 E.A. Electronic Combination lock (including lock)
M40 E.A. Mast Head Amplifier
M41 ETI 576 Electromyogram
M42 E.A. Prospector Metal Locator including headphone
M43 ETI 561 Metal Locator less dowel and tubing potplant stand
M44 E.A. Musical Tone Generator
M45 E.A. Light Chaser 3 channel
M46 E.A. Power saver for Induction motors
M47 E.A. Twin Tremelo for Organs/Stage Amps
M48 E.A. Lissajouis Pattern Generator
M49 E.A. Selectalott
M50 ETI 1500 Discriminating Metal Locator
M51 E.A. Light Chaser
M52 E.A. Cylon Voice
M53 E.A. Universal Timer Stop Watch
M53 ETI 566 Deep Seeking Meal Locator.
M55 ETI 562 Geiger Counter
M56 ETI 607 Sound Effects

E. D. & E. (SALES) PTY. LTD., NOW

ALL ELECTRONIC COMPONENTS

118 LONSDALE STREET, MELBOURNE, VIC. 3000. TEL: 662-3506.

JAYCAR KITS

WHERE PERFORMANCE IS MEASURED IN RESULTS!

8 CHANNEL MIXER KIT
AVAILABLE SHORTLY
RING FOR THE PRICE

We are completing work on our new 8-channel stereo mixer

*8 balanced inputs, 2 outputs * Mic, line, line -20dB inputs * * Input attenuator * Bass, treble and mid range equalisation * * Foldback send, effects send * 19" rack mount * 5 band graphic on masters * VU meters * Console mount version will be available * XL-connectors used.

SEND SAE FOR MORE INFORMATION P.O.A.

GUITAR PHASER KIT

Get great Phasing Effects from your Guitar or Synthesiser (or anything) at a fraction of the cost of commercial units. Easy to construct, this really effective Phaser gives a truly professional sound.
Based on Aug. '81 "hobby Electronics"

ONLY $26.50 including all parts

26.50

ETI KITS

446 Audio limiter	$12.00
480 50 watt PA module	$23.00
480 100 watt PA module	$27.00
466 300 watt PA module (Inc. heavy heatsink bracket)	$70.00.
477 100 watt Mosfet PA module	$59
581 General purpose +/-15V Power Supply	$15.50
729 UHF masthead amp	$35.00
489 Audio Spectrum Analyser (comp kit featuring rectangular LEDs)	$155.00
330 Current trip car alarm (inc. LM394 IC)	$24.50
735 UHF convertor	$32.50
458 Peak reading level meter	$29.50
445 General purpose preamp	$7.99
478M.C. Moving coil preamp (as used in 5000 preamp)	$26.50
478M.M. Moving mag. preamp (as above)	$19.50

EA KITS

Graphic analyser EA4/81	$89.00
Colour option	$25.00
Horwood cabinet to suit above	$16.50
"Le Gong" EA3/81	$13.95
P.C. Birdies EA5/81	$14.95
2 channel Infra Red remote control EA5/81	$65.00
Sound level meter EA5/81	$32.00
Audio oscillator EA6/81	$64.50
Musicolor IV EA8/81	$94.50
Photon torpedo EA9/81	$29.50
Cassette deck audio test unit EA10/81	$45.00
Jaycar CLEF string synthesiser	$445

SUPER 80 USERS PLEASE NOTE!!

We stock "Blue Chip" 0.1uF By-pass capacitors — low inductance type for de-glitch of RAM & CPU circuits. The inductance of ordinary ceramics does not guarantee suppression of fast rise time pulses. Blue Chips are used by the pro's but you can use them too because they aren't expensive!!
ONLY 30 cents each
They measure a tiny 5mm square.

POST AND PACKING

$5 — $9.99	$1.00
$10 — $24.99	$2.00
$25 — $49.99	$3.00
$50 — $99.99	$4.00
$100 up	$5.50

EA 500MHz FREQUENCY COUNTER KIT

This fantastic new SECOND GENERATION frequency counter is the result of years of expertise in DFM design at EA. The Jaycar 500MHz DFM conforms exactly to the original EA design. BEWARE OF ADVERTISED KITS THAT DO NOT USE THE SPECIFIED DESIGN OR COMPONENTS. THEY MAY HAVE INFERIOR PERFORMANCE.

STANDARD KIT IN MAGNIFICENT PAC-TEC BOX

50MHz VERSION **$119**

500MHz OPTION ONLY $26 EXTRA

EXCLUSIVE!! THE JAYCAR KIT USES 1% 50 P.P.M. RESISTORS THROUGHOUT — EVEN WHEN NOT SPECIFIED!!

BOOKWORMS CORNER

We stock a great range of brand new titles which you won't normally find anywhere else:

"Electronic Synthesiser Projects" By M.K. Berry. Great book for people who want to learn more about Synthesisers. Learn about VCO's, VCF's, analogue delay lines, sequencers, envelope shapers etc. Full of circuits and not expensive. Over 80 pages. measures 110x180mm. **ONLY $6.45**

"VMOS Projects" Power Mosfets & VMOS devices discussed in great detail. Many circuits. **Only $7.20**

"Remote Control Projects" Covers infra red, visible light, RF, and ultrasonic controls. Many projects described. Value at only **$6.95**

"Electronic Music & Tape Recording" Shows how to lay down a professional sound on your own tape deck. Sections on mixing and special effects. Great value **$4.60**

"Electronic Circuits For Model Railways". Great book of circuits for the railway enthusiast, eg. electronic steam whistle, "Chuff" generator, simulated inertia, high controller and many more. Only **$3.65**

"Build your own Hi-Fi and Audio Accessories". Circuits include channel mixer, FET preamp, dynamic noise limiter, VOX relay, speaker protector & many others. Only **$3.10**

"How to make Walkie Talkies" One of the most popular books of its kind ever sold in the UK. We're sure that it would enjoy similar success over here. Full of circuits. **$5.50**

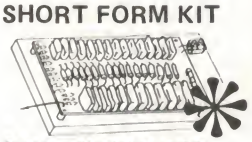
"IC 555 Projects" Fun book giving many circuits and ideas to 555 timer fans. **$6.45**

IONISER KITS

HIGH POWER

- runs directly from 240V mains
- low power consumption
- produces high intensity electric field
- output around 7.5KV
- Will not necessarily produce ozone in standard form
- ideal for those who wish to 'try' an ioniser at an economical price

SHORT FORM KIT



ONLY $24.50

COMPLETE

Based on the short form IONISER.

- redesigned PCB
- High efficiency emitter head
- Fits completely inside a high quality ABS box (not a metal lid)
- only 2-core mains flex protrudes from the box

Why not make one as a Christmas present for a friend?
— you can pay over $80 for a built-up inferior unit!

ONLY $45.00

PLESSEY-FOSTER SPEAKERS

STOP PRESS!! We are now stockists of the value for money Foster Hi Fi speakers.

*12" Woofer 50W nominal	C-300L05	$29.95
*8" Woofer 15W nominal	C200L09	$12.00
*5¼" Midrange 30W nominal	C130M06	$11.50
*5¼" Midrange 60W nominal	C13M08	$18.00
*2" Dome tweeter 60W nom.	C050N08	$6.95
*1" Dome tweeter 30W nom.	D025N15	$11.50
*Aluminium Diaphragm Super Tweeter 50W nominal	H016N17	$17.00
*4" Wide range 10W nominal	C100K03	$8.95
*5" Wide range 12W nominal	C130K03	$9.50
*6" Wide range 20W nominal	C160K03	$12.50

We also stock Foster mid-range P.A. Horns & other units too numerous to mention.
DON'T FORGET US FOR ETONE SPEAKERS EITHER!

DRUM SYNTHESISER KIT

JOIN THE DRUM REVOLUTION

Original design from the UK magazine "Electronics and Music Maker" April 1981.
This self-contained unit can produce a variety of fixed and falling pitch effects triggered either by tapping the unit itself or striking an existing drum to which the unit is attached!!
The Jaycar "SYNTOM" Drum Synthesiser comes complete with a high quality PRE-DRILLED moulded all ABS* box (even the lid) with professionally silkscreened front panel. It is not a cheap looking utility box!
FEATURES: Decay from less than 0.1 second to several seconds. Pitch control — sweep control and volume on/off.
These controls, when used in combination with each other enable the most popular drum synthesiser effects heard on commercial recordings to be obtained.
JUST PLUGS INTO ANY AMPLIFIER AND YOU'RE AWAY!!
* Box measures 152 x 80 x 47mm.
As used by WARREN CANN of "ULTRAVOX"
Send $2.00 and SAE for more information.

ONLY **$36.50**

Jaycar

NOTE! NEW SHOP HOURS
Mon - Sat 9am — 5.30pm
Sun - 10am — 2pm
Open Thursday night until 8pm.

380 Sussex St Sydney 2000
Ph. 2646688 Telex 72293
Mail Orders To: Box K-39 Haymarket 2000

Get your BELOW COST copy of EA and ETI from us — quantities limited!! $1.00 each

Lab Notes

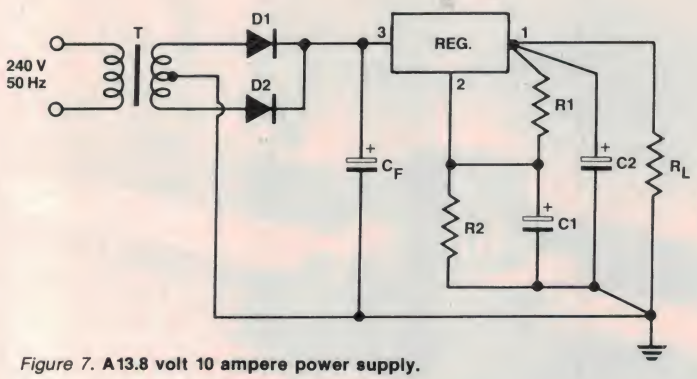


Figure 7. **A13.8 volt 10 ampere power supply.**

The complete circuit can now be built, incorporating Figures 4 and 5. The circuit diagram of the final 13.8 V 10 A power supply is shown in Figure 7.

Component values for Figure 7.

T = 240 : 30 CT at 12 amperes.
D1 = 16F10 DO-4 case.
D2 = 16F10 DO-4 case.
CF = 26500 μF 40 VW (ideally, capacitors in parallel).
C1 = 25 μF 16 VW.
C2 = 4μ7 tantalum 16 VW.
R1 = 120 ohms 1% metal film.
R2 = 1k2 1% metal film.
Reg = LM396 on a 6" 55 or 65D heatsink.

$$V_{out} = 1.25 \left(\frac{R1 + R2}{R1}\right)$$
$$= 1.25 \left(\frac{120 + 1200}{120}\right)$$
$$= 1.25 \times 11$$
$$= \underline{13.75 \text{ volts}}$$

A highly desirable situation would be to *reduce* the power dissipated by the regulator. This can be achieved by supplying part of the output current around the regulator as shown in Figure 8.

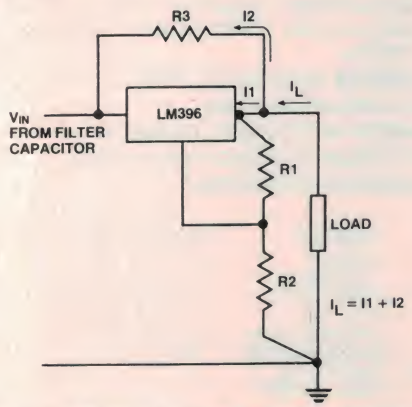


Figure 8. **Reducing regulator power dissipation**

Resistor R3 is selected to supply a portion of the load current. In this case a *minimum load must always be maintained.* This prevents the regulated output from rising uncontrolled. The value of R3 must be greater than:

$$\frac{V_{max} - V_{out}}{I \text{ min}} \text{ ohms}$$

Where: V_{max} is worst case high input voltage.
I_{min} is the minimum load current.
Power rating must also be considered and R3 must be rated at a minimum of:

$$\frac{(V_{in} - V_{out})^2}{R3} \text{ watts}$$

This circuit configuration will reduce the regulator power dissipation by a factor of 2 to 3, if the minimum load current is about 50% of the full load current.

Precautions when using R3

1. The power rating of R3 must be *increased* to $\frac{(V_{max})^2}{R3}$ watts if continuous output short circuits are at all likely.
2. Under short circuit conditions the *overall circuit* power dissipation increases by $\frac{(V_{in})^2}{R3}$ watts.

The regulator and R3 will not be harmed (if R3 is the correct wattage), but the circuit components prior to the regulator (diodes, transformer) must be able to withstand the overload condition (i.e: the power rating is sufficient to handle the excess current).

The only problem with this technique is the large power rating required for resistor R3. If $V_{in} - V_{out} = 7$ volts and R3 = 2 ohms, the power dissipated by the resistor is:

$$\frac{(7)^2}{2} = 24.5 \text{ watts}$$

with 3.5 A of current passing through it.

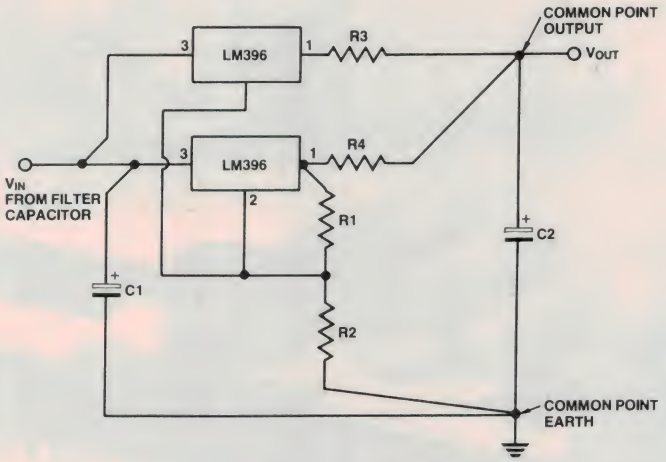


Figure 9. **Quasi-parallel regulators**
R1 = 120 ohms
R2 chosen to set V_{out}
R3, R4 = 0.015 ohms
C1 = 4μ7 tantalum
C2 = 100μF

High Current Output

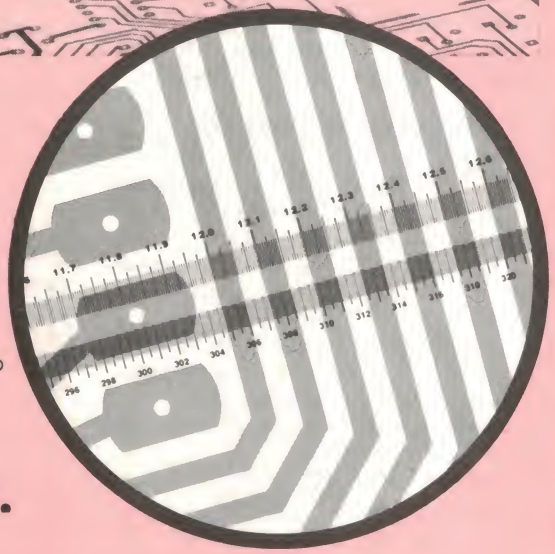
Placing regulators in parallel is not recommended because they may not share the current equally. The regulator with the highest reference voltage will handle the highest current up to the time it current limits. Therefore, one regulator may be flat out handling 16 A while the other is cool and calm passing only 2 A. Reliability cannot be guaranteed under these conditions because of the high junction temperature of regulator one.

However, if load regulation is not critical, the regulators may be connected quasi-parallel, as shown in Figure 9. This circuit will share current to within 1 ampere, and in the worst case 3 amperes. However, the payoff is in the load regulation. It is degraded by 150 mV at 20 ampere loads compared to about 20 mV with 10 ampere loads. This should not cause too much of a problem in higher voltage power supplies. ●

Acknowledgement

This article was made possible by the courtesy of National Semiconductor. Data and basic circuits were taken from their publication 'LM196/LM396 10 Amp Moose Adjustable Voltage Regulator'.

±0.013 mm OPTO-SCALE®



Affordable Accuracy from

The Innovators

Bishop Graphics, Inc.®

introducing OPTO-SCALE from Bishop Graphics, the first glass linear measuring instrument to combine precision accuracy, functional design, hi-tech quality and unique performance features in one compact unit...all at an easily affordable price. With OPTO-SCALE there's no need for guesswork. The 610mm (24") precision scale pattern gives you overall accuracy to ±0.013mm (.0005"), with an incredible ±0.005mm (.0002") between adjacent lines.

Adaptable to virtually any precision linear measuring need, OPTO-SCALE is especially useful in the design and manufacture of printed circuit boards. From checking the accuracy of master artwork to the inspection of reproduction negatives and the final product, OPTO-SCALE'S ±0.013mm (.0005") accuracy is your assurance of quality results.

Instantly convertible at a glance, the dual aligned inch/metric scale pattern is chrome etched on the underside of OPTO-SCALE'S thick, stable glass plate. This combined with our unique parallax eliminator assures accuracy to ±0.013mm (.0005")...even on uneven surfaces. Twin, full focusing, 10 power optics and clear, smooth gliding cursors offer the ultimate in sharp, stable viewing of both your work and OPTO-SCALE'S inch/metric scale pattern. OPTO-SCALE'S sturdy, attractive, black anodized all aluminum frame is engineered for easy portability, yet it's heavy enough to stay where you put it. OPTO-SCALE even comes with its own protective storage container.

So, if you want to improve your linear measuring accuracy, without destroying your budget, choose OPTO-SCALE...affordable accuracy from Bishop Graphics.

FOR THE COMPLETE OPTO-SCALE STORY... INCLUDING A FREE OPTO-SCALE DEMONSTRATION AND BISHOP TECHNICAL BULLETIN NO. 1023R, CONTACT YOUR LOCAL BISHOP GRAPHICS DEALER TODAY!

A.C.T.
GEORGE BROWN & CO. PTY. LTD.
23 Whyalla Street
Fyshwick A.C.T. 2609
Tel: 80 4355
Telex: AA 62128

NEW SOUTH WALES
CIRCUIT COMPONENTS (A/Asia) PTY. LTD.
P.O. Box 70
383 Forest Road,
Bexley N.S.W. 2207
Tel: 59 6550 59 3720
Telex: AA 27197 CIRCOM

QUEENSLAND
L. E. BOUGHEN & CO.
Cnr. Baroona & Milton Rds.
Milton Qld. 4064
Tel: 36 1277
Telex: AA 41500

SOUTH AUSTRALIA
GRAPHIC ELECTRONIC INDUSTRIES PTY. LTD.
41A Rundle Street
Kent Town S.A. 4067
Tel: 42 6655
Telex: AA 88646

VICTORIA
CAMDEN ART CENTRE PTY., LTD.
Post Office Box 117
188-200 Gertrude St.
Victoria 3065
Tel: 41-96633
Telex: 36077 CAMART AA

VICTORIA
STEWART ELECTRONIC COMPONENTS PTY. LTD.
44 Stafford Street,
Huntingdale 3166
Tel: 543 3733
Telex: AA 36908

WESTERN AUSTRALIA
W. J. MONCRIEFF PTY. LTD.
176 Wittenoom Street,
East Perth W.A. 6000
Tel: 325 5722
Telex: AA 93022

MERRY XMAS TO ALL OUR CUSTOMERS

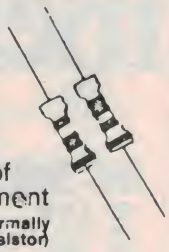
ROD IRVING ELECTRONICS

425 High St, Northcote. Vic.
Phone (03) 489-8131. Telex 38897

COMPONENT SPECIALS

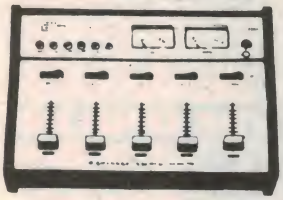
	1–9	10+
2708	$5.20	$4.50
2716	$5.20	$4.50
4116	$2.00	$1.80
2732	$9.00	$8.50
2114	$2.00	$1.80
2114 LP3	$2.50	$2.00
Z80 P10	$5.90	$5.25
BUX80	$5.50	$4.90

FREE!!
250 pack of resistors on purchase of over $10 on presentation of this advertisement
Save $10 (Normally 4¢ per resistor)



NEW

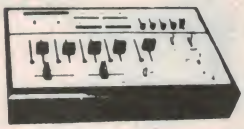
AUDIO MIXERS



- 2 Hi-Low microphone inputs
- 2 Magnetic/Ceramic phono inputs
- Also tape and tuner inputs
- 2 VU meters
- Stereo or mono
- Independent CUE on each chan
- Compact size. 26 x 20 x 6.5cm
- 9V battery operation, ext DC input socket

$89

PRO Model



- Facilities for 4 stereo program input and 2 mic inputs
- Built-in low noise preamplifier for magnetic phonos and low or high impedance microphones
- Professional stereo slide controls
- Headphone circuits to monitor each input and output
- Talk switch to attenuate music volume 14db so mic's can be used without readjusting music levels
- 5 channel stereo graphic equalizer section using separate slider controls
- Meters monitor the output of left and right channels independently

$189

"Selectalott"

With this great little kit you don't have to bother about thinking up numbers anymore. It features 40 LEDs and tells you what numbers to choose. Great for picking a winner

$22.50

CYLON VOICE

Are you sick and tired of that boring voice? Build this delightful little kit and impress your friends with the Cylon Voice

$18.50

'LE GONG' door bell kit

Are you sick of ding-dongs? You don't have to spend a fortune to hear a pleasant sounding doorbell. This great little kit does the job simply and cheaply (pushbutton not included)

$15.00

ROD'S REAL VALUE SPECIALS

TRIO CRO'S NOW IN STOCK
(write for full product range and price list)
130 mm DUAL-TRACE
15 MHz, TRIGGERED SWEEP
OSCILLOSCOPE

TRIO $495
plus tax

- Simplified circuitry improved performance and dependability have been successfully realised with the use of IC's throughout
- A vertical amplifier provides as wide a bandwidth as DC to 15 MHz, as high a sensitivity as 10 mV/div, and a low input capacitance
- A sweep rate extends from 0.5 sec/div to 0.5 sec div in 19 ranges. Further, TV vertical and horizontal syncs are available for measuring video signals, and with its ×5 magnified sweep, its range of application is extremely wide
- Very easy X Y operation of high input sensitivity for Lissajous measurements
- Dimensions 260(W) × 190(H) × 385(D) mm. Weight 8.4kg

sinclair: you're the greatest, now better than ever.

ZX81

Personal computer, **$245** $220 TAX EX.

Incl sales tax pack/post

COMPLETE WITH MAINS ADAPTOR, LEADS & BASIC MANUAL

REGULATORS

	1-9	10+
7805	90c	80c
7812	90c	80c
7815	90c	80c
7818	90c	80c
7824	$1.00	90c
7905	$1.20	$1.10
7912	$1.20	$1.10
7915	$1.20	$1.10
7924	$1.20	$1.10

REED SWITCH AND COIL 30¢
NOW THRASHED TO RIBBONS 60¢

RACK MOUNTING BOX

from $35

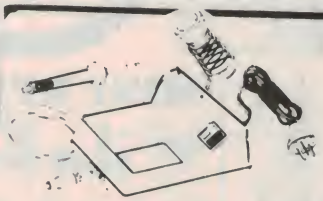
Beautiful fashionable sturdy durable matt black finish

1-4 $39.95
5 up $35.00
Standard 19" (48.3cm) stacking

RELAY

- 8-12 V DC operation
- 225 OHM coil resistance
- Silver change over (S.P.D.T.) contacts handle up to massive 2 amps at 24 V DC or 100 V AC
- Mounts directly on to PCB
- Ideal for many applications

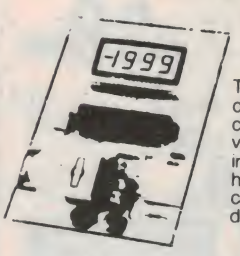
SAVE	1's	10's	25 up
	$1.50	$1.20	$1.00



WELLER SOLDERING STATION

A transformer powered soldering station, complete with a low voltage, temperature controlled soldering pencil. The Special Weller features a 'closed loop' which controls maximum tip temperature, thereby protecting temperature sensitive components while the grounded tip protects voltage and current sensitive components. Features: ● quick connect/disconnect plug for the soldering iron ● extra large wiping sponge ● tip tray to store extra tips ● 2m flexible 3-wire power cord.

ONLY $58.50



LCD PANEL METER KIT

This economical evaluation kit features on-board clock and reference, accuracy guaranteed to ± count over entire 2000 counts, single reference voltage for ratiometric operation plus many more important features. Kit includes PC Board & hardware, A/D converter, LCD display, resistors, capacitors, wiring diagram, application notes and data sheet (power supply not included).

$32.50

TO ORDER: Heavy items sent Comet Freight on. Mail Order phone 481-1436. Wholesale Customers phone: RITRONICS WHOLESALE 489-7099 or 489-1923. Mail Orders to P.O. 235 Northcote 3070. Minimum mail order $2. Add extra for heavy items and registration, certified mail. Prices, spec. subject to change without notice.

merry discounts and a happy purchase!

DECEMBER price reductions

- JUNIOR WALKIE-TALKIES 27MHz IDEAL FOR CAMPING, HIKING, ETC $17.95 **$14.00**
- LCD DIGITAL DE-LUXE WATCHES GOLD OR SILVER STYLE mens $14.99 **$10.00** ladies $15.99 **$10.50**
- 8" QUARTZ WALL CLOCKS, WHITE BATTERY OPERATED, GUARANTEED $17.50 **$14.50**
- PORTABLE CLOCK-RADIO, LATEST COMPACT, WITH ALARM! $19.50 **$15.00**
- AM/FM BATTERY/ELECT. RADIO IN LEATHERETTE CARRY-CASE. $19.00 **$9.00**
- DE-LUXE MOTORISED CAR AERIAL 5 STAGE 12V NEGATIVE GROUND. $19.95 **$16.00**
- RECORD CLEANING ARM, UNIVERSAL CLEANS RECORDS WHILE YOU PLAY! $3.95 **$2.50**
- 7 WAY STEREO SPEAKER SWITCH WALL-MOUNTED, 1,2,3 PAIRS SPKRS. $9.50 **$7.00**
- 10" 25W FOSTER BASS SPEAKERS ROLLED-EDGE SURROUND, QUALITY $24.50 **$20.00**
- 4CH MONO/2CH STEREO MIXER HI-IMP UNIVERSAL INPUTS, BATT $24.50 **$20.00**
- 5CH STEREO DISCO MIXER, VU'S 2 PHONO, MIKE, TAPE/TUNER, CUE $92 **$69.00**
- ELECTRET DESK MICROPHONE FLEX. SHAFT, PUSH TALK SWITCH $23 fo **$20.00**
- MICROPHONE FLOOR STANDS POPULAR TRI-STAND BASE, ADJUST. $35 **$27.50**
- SCOPE CORDLESS SOLDERING IRON RECHARGEABLE, 60 WATT $55.00 **$49.00**
- SCOPE METAL ETCHING TOOL IDENTIFY OR LABEL TOOLS, ETC. $21.50 **$16.00**
- EX-COMPUTER ELECTROS, G'TEED 1000's MICROFARADS AT ½ PRICE! PRICES AS MARKED!

25,000uF..10v..	$2.00	50,000uF..30v..	$5.00
42,000uF..10v..	$2.50	3,150uF..40v..	$1.00
100,000uF..10v..	$3.00	21,000uF..40v..	$4.00
150,000uF..10v..	$4.00	33,000uF..40v..	$4.50
51,000uF..15v..	$4.00	31,000uF..50v..	$5.00
39,000uF..20v..	$4.00	9,400uF..75v..	$4.50
10,000uF..25v..	$3.00	4,800uF..200v..	$6.00

WE HAVE A HUGE RANGE AVAILABLE IN OUR STORES, SO ASK FOR YOUR REQUIREMENTS!

DC MOTORS

6-12V

LARGE SIZE! IDEAL FOR TOYS, MODEL BOATS, CARS, HOBBY ETC. OPERATES FROM 4.5V TO 12V, POWERFULL AND RUGGED, SIZE 47MM DIAM x 60MM

$3

VHF COUPLERS

100-150MHz NEW

Made in USA by MICROLAB, worth over $100 each. Just add 2 microwave diodes, or 1N21,1N23 etc, use for SWR or RF sampler. Ideal for 144MHz HAMS.

$25

FACTORY CLEARANCE BY PHILLIPS

$12.99

Parcels of good gear for hobbyists and experimenters- we bought over 2 TONS, as used in PHILLIPS RADIOS, STEREOS AND TV's etc. Each JUMBO PARCEL weighs over 2KGms, worth approximately $40-$50

PARTY STROBE

IDEAL XMAS PRESENT! NORMAL PRICE $29.95 SAVE NEARLY $5. "Freeze" the action at your next party or theatrical show! Mains operated with a continually variable flash rate, housed in an attractive black vinyl box 150mm

$25

LEDs

3mm Round
RED....10¢
GREEN..15¢
YELLOW..15¢
5mm Round
RED....10¢
GREEN..15¢
YELLOW..15¢
5x2mm Rect
RED....20¢
GREEN..25¢

from 10¢

SOCKETS

HIGH QUALITY LOW PROFILE

8 or 14P	5 for $1
16 PIN	4 for $1
18 PIN	3 for $1
24,28P	2 for $1
40PIN	1 for $1

TRIMPOTS

Save! BUY 100 for $8 OR 10 for $1 CHOICE OF- 100, 470, 1K, 10K, 25K, 50K, 220K, 500K, 2M

SEMICONDUCTORS

POWER

2N3055	0.85
2SD350	$3.50
BU126	$1.25
BU326	$1.85
SDT9210 40v 10A 70w NPN	0.50
BC204 (BC557)	5¢
2N3054	0.50
2N3053	0.20
BD438 45v4A	0.30

VARIAC VARIABLE TRANSFORMERS

120V AC
2.5 Amps

$10 EA

Buy 2 for use on 240V, wiring diagram incl, standard 10mm pot-hole mtg. open construction, ex-computer and g'teed. Others for 240V from $40.00.

KEYBOARDS

$49 COMPLETE IN SLOPEING METAL BOXES

Top quality keyboards from famous makers. Limited quantity available. Standard typewriter layout with a few extra keys for your own use. They are assumed to be in good working order, however no warranty can be applied. The PCB includes all necessary electronics. Sorry, no data available.

THE COOLERS

Squirrel-Cage FANS SINGLE OUTLET 115V OR 220V AC

$14 $20

Very rugged, powerfull, ex-computer blowers.

power supplies **$35**

OUTPUT
+50V 12A
+24V 1A
-24V 1A
+5V 4A

FAN-COOLED

THIS MONTH'S SPECIAL OFFER

CAR AERIALS

$3.50 **$1.50**

WITH LEAD AND PLUG
PERSONAL SHOPPERS ONLY!

$12.99 STEREO CASSETTE PLAYER

- USUALLY OVER $20
- AUTO-STOP MODEL
- 4W/Chan in 4 ohms
- 12V neg. Ground
- Mini-Size,
- SPEAKERS Extra, add $8.95 pair.

MINI RELAYS

EA. **$1.49**

SPDT 8 TO 15V DC, 225 OHMS, PCB MOUNTING

DPDT 24V, 700 OHMS, 5A CONTAC

240V AC HEAVY DUTY 10A CONTACTS 4 CHANGEOVER

Great value, worth over $5 **$2.50** huge purchase enables us to sell for less than HALF! Buy 10+, $2.25

Take your pick, great value, limited quantities avail.

12V DC to 240V AC POWER INVERTER

RUNS FRIDGES, TV's, RADIOS LIGHTS, ALMOST ANYTHING! REGULATED OUTPUT, 240V ± 5% RMS 50Hz ± 0.5% INPUT 11-15V DC **$209**

NORMALLY $249, SAVE $40

With reversal switch, use as a battery charger, 7A output from 240V mains.

6V BATTERIES

DRY -CHARGED LEAD-ACID ACCUMULATORS **$8.99**

IDEAL FOR BURGLAR ALARMS, PORTABLE VIDEO/STEREO EQUIPMENT, TOYS, BIKES, ETC. SIZE 120x130x60MM.

BATTERY CHARGER or POWER SUPPLY 6 VOLT DC 2A

LIMITED QUANTITY

IDEAL CHARGER FOR THE 6V BATTERIES ABOVE! AUST. MADE BY FERGUSON AND FITTED WITH 3 CORE MAINS LEAD, FUSEHOLDER AND INDICATOR LIGHT, METAL CASE 100x70x58MM

$14.50 **$7.50**

THE MODERN PHONE DIALER

- EASY INSTAL IN MINS
- ONLY 3 WIRES
- IVORY COLOUR
- FULLY G'TEED
- LED INDICATOR
- LAST NUMBER MEMORY REDIAL if called number is engaged

Direct replacement for rotary dial. Not approved by Telecom currently.

$29.99

FM MIKE

Dual purpose, wireless or conventional mike with lead! Omni-directional, with electret

$21.98

12V DC ROTARY SOLENOID STEPPING SWITCH

U.S.A. Made!

$19.99 12 POSITION, SINGLE POLE, SHORTING.

IC's "SWEEPINGS OFF THE FACTORY FLOOR"

Approx 100 ASST. FOR **$11.50**

1000 for $100

High Quality speaker KIT specialists

BOXES ONLY

EA. **$44** SPECIAL PRICE!

These beautiful teak wood-grain finish cabinets used to be $118.00PR. Now we need the space for new lines, so, YOU SAVE $30! Holes are already cut for a 12", 5", and 3" speaker combination.

The "wrap-around" grille is removable, and complements the superbly-finished boxes. Recessed speaker terminals are supplied. Add only Innerbond ($3 each box) and speakers. Coral 12" 60W speakers at $139.00PR are ideal. Size, 660 x 440 x 300mm deep. Weight, 10Kgm each, "freight to pay" by road or rail.

PRE-PAK electronics

569-9797

PACK/POST: ADD 10% ORDER VALUE

SHOP: 1A WEST ST, LEWISHAM NSW
MAIL: P.O. BOX 43, CROYDON NSW 2132

open 7 days

SEE THE HUGE RANGE IN-STORE!
IF YOU THINK WE PACK A LOT INTO OUR ADS, YOU SHOULD SEE WHAT'S IN OUR SHOPS!

ALSO AT

PUNCHBOWL

1190 CANTERBURY RD, PUNCHBOWL, NSW 2196
(NEAR ROSELANDS SHOPPING CENTRE)

Electronics specialists

NOW 2 STORES FOR BIGGER BULK BUYING POWER AND MORE CONVENIENT SHOPPING!

Save! Save! Save!

Hey look us over!

DISCOUNT PRICES

Do-it-yourself SPEAKER KITS

3 Way, 25W
8 OHMS, 55Hz-18KHz Hi-Fi sound, wood-grain finish with black grille cloth. Boxes are ready-made for easy finish in 2 hours.

1/2 PRICE HI FI SPEAKERS

PR ONLY $69

Sounding GREAT with an 8" woofer, a 5" mid-range and a 3" tweeter with X'overs plus wire and Innerbond and screws.

Speakers

8" WOOFER 8Ω 25W RATING 55-5KHZ 7.50

5" MID-RANGE 500-12KHz 5.95

3" TWEETER 5KHz-18KHz 4.50 GREAT VALUE!

CROSSOVER NETWORK 800Hz, 5KHz 6.90

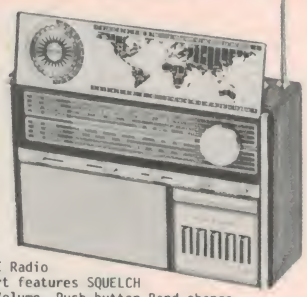
Hi Fi for Cars

ADJUSTABLE SHAFTS!

AM/FM STEREO CASSETTE 15W + 15W $139

This 15 watt/channel (in 4 ohms) AM/FM Stereo Radio/Cassette mounts in-dash and features AUTO-REVERSE and fast forward and rewind controls. Usually $179.

5 BAND AM/SW/MB/FM/VHF RADIO BATTERY/ELECTRIC $59



WAS $69, SAVE $10

Healing WORLD-RANGE Radio with time-zone chart features SQUELCH control, Tone and Volume, Push-button Band-change Switch and large Slide-Rule Dial for easy frequency tuning

Covers AM 540-1600KHz, SW 4-12MHz, MB 1.6-4 MHz, FM 88-108 MHz, VHF 108-174MHz. Mains or Battery Operation.

SUPER SPECIAL OFFERS – TOO GOOD TO REFUSE!

NO.1 IN CAR STEREOS !

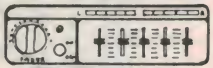
STEREO CASSETTE HIGH POWER! **2x20W 4Ω** Under-Dash mtg, LED bar-graph display, AUTO-STOP, mini size **$75**

CAR SPEAKERS

3 WAY SPEAKER SYSTEM CHOICE OF 2, BEST VALUE EVER! The RH one is 20W 4Ω Ferris quality, was $65 PR, Save $10 The LH one is 30W 4Ω imported HIGH QUALITY River-Tone speakers. $69.50 PR

$55.00 PR

STEREO BOOSTERS



WITH GRAPHIC EQUALIZERS $69

24W+24W AND ILLUMINATED FRONT PANEL PROTECTED SPEAKER OUTPUTS! $55

LED BAR-GRAPH DISPLAYS PLUS FADER CONTROL - HI QUALITY

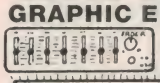
25Wx2 LED BAR-GRAPH POPULAR MODEL

AM/FM RADIO/AUTO EJECT CASSETTE SAVE $20 **$229**

WITH DOLBY AND PUSH-BUTTON TUNING

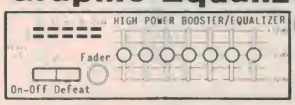
ALSO LOCKING FAST FORWARD AND REWIND, SEPARATE BASS AND TREBLE CONTROLS PLUS 7 WATTS OUTPUT PER CHAN. IN 4 OHMS - UNIVERSAL IN-DASH INSTALLATION

25Wx2 BOOSTER/GRAPHIC EQUALIZER SAVE $50 WAS $79 **$49**



BONUS: 2 HIGH QUALITY CASSETTE TAPES WITH CAR HI-FI PURCHASE!

Graphic Equalizer-Amplifier



60 Watt 7-Band $85 SAVE $10

DE-LUXE MODEL WITH "DEFEAT" SWITCH AND LED OUTPUT POWER INDICATORS

GRAPHIC GIVES 12dB + and - AT 60Hz, 250Hz, 500Hz, 1KHz, 4KHz, 8KHz, 15KHz, FREQ.

RADIOS ... BELOW HALF PRICE

PORTABLE AM EACH **$2.99**

6 TRANSISTOR POCKET RADIOS, WERE $5.99

NOVELTY AM RADIOS AS ABOVE, WERE $5.99 EA **$2.99**

BATTERY/ELECTRIC LARGER PORTABLE OR MANTEL MODEL WITH LEATHERETTE COVERED CASES. EACH **$8.99** $19.95

AM-FM PORTABLES MODERN-STYLED, BATTERY-OPERATED RADIOS WITH 88-108MHz FM BAND. WERE $17.95, NOW LESS THAN HALF PRICE! EA **$7.99**

TRAVELING CLOCK-RADIO

$6.99 WERE $19.99 TO CLEAR. SAVE $13.00

RADIO AND CLOCK FOLD AWAY INTO STRONG LEATHERETTE COVERED CASE WHEN NOT IN USE. IDEAL CHRISTMAS PRESENT

INCREDIBLE TRADE-INS

CAR STEREO

COMPARE OUR PRICES before you buy

YES, WE TRADE ANYTHING ON ANYTHING! JUST BRING YOUR TRADE-IN DOWN TO OUR STORE IN WEST ST (ALMOST AT THE CORNER OF PARRAMATTA RD), AT LEWISHAM AND WE'LL TRY TO MAKE YOU AN OFFER YOU CAN'T REFUSE!

SERVICE, MODIFICATIONS AND A LARGE RANGE OF SPARE PARTS AVAILABLE TOO!

WE HAVE PROBABLY THE LARGEST RANGE OF PARTS AND ACCESSORIES IN SYDNEY PLUS A HUGE DISPLAY RIGS ETC, INCL. MOST BRANDS.

transceivers

PRESIDENT **GRANT 18 Chan** **$299**

INCL. TOP-QUALITY AERIAL AND BASE, LEAD ETC, PLUS SWR METER. Optional 40Channel switch avail, $30 extra (fitted)

WEATHERPROOF ANTENNA BASES

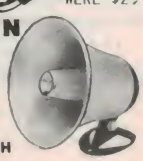
For all Australian made HF communications aerials - ensures good ground contact - rugged and reliable - easy to instal on cars, boats, etc. Usually $4.50. SPECIAL ONLY **$3**

27MHZ CB AERIAL

This HEAVY-DUTY, FULLY-ADJUSTABLE, HELICAL Aerial is the one the "Truckies" LOVE! Aussie-made for standard black HF bases. No post, rail freight only. WAS $23.50. **$16**

ROTATING EMERGENCY LIGHT 12v DC OPERATION WITH CAR CONNECTOR CORD. WERE $29 **$25**

5 WATT HORN SPEAKER 5" 8OHM METAL WEATHER-PROOF HORN SPEAKER WAS $9.99 **$7.99** EACH



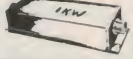
CB CRYSTALS 1 PAIR **$2.50** All new and g'teed! TRANSMIT/REC. Scoop buy! Were $4.50 Save $2.00 EACH **$1.99** 10 PAIR or more

CHAN	FREQUENCY	CHAN	FREQUENCY
4	27.055	15	27.185
5	27.065	16	27.195
7	27.095	17	27.205
8	27.105	18	27.225
9	27.115	MARINE	27.880
11	27.135	MARINE	27.890
12	27.155	MARINE	27.900
13	27.165	MARINE	27.910
14	27.175		

CB, HAM RADIO ACCESSORIES

MIKE for CB GENERAL PURPOSE REPLACEMENT **$8.99**

1KW TVI FILTER SHINWA "BIG-GUN" DE-LUXE MODEL **$17**



COMMUNICATIONS POWER MICROPHONE Lesson high quality with compression, LOW NOISE **$19**

30% OFF WERE $7.50 LADIES HAIR **CURLING WANDS** NOW ONLY **$4.99** ALL 240v, GREAT XMAS GIFT!

40 Chan SWITCH for CYBERNET Sets $16

G.I.S. ELECTRONICS SYDNEY'S NEW ELECTRONICS CENTRE

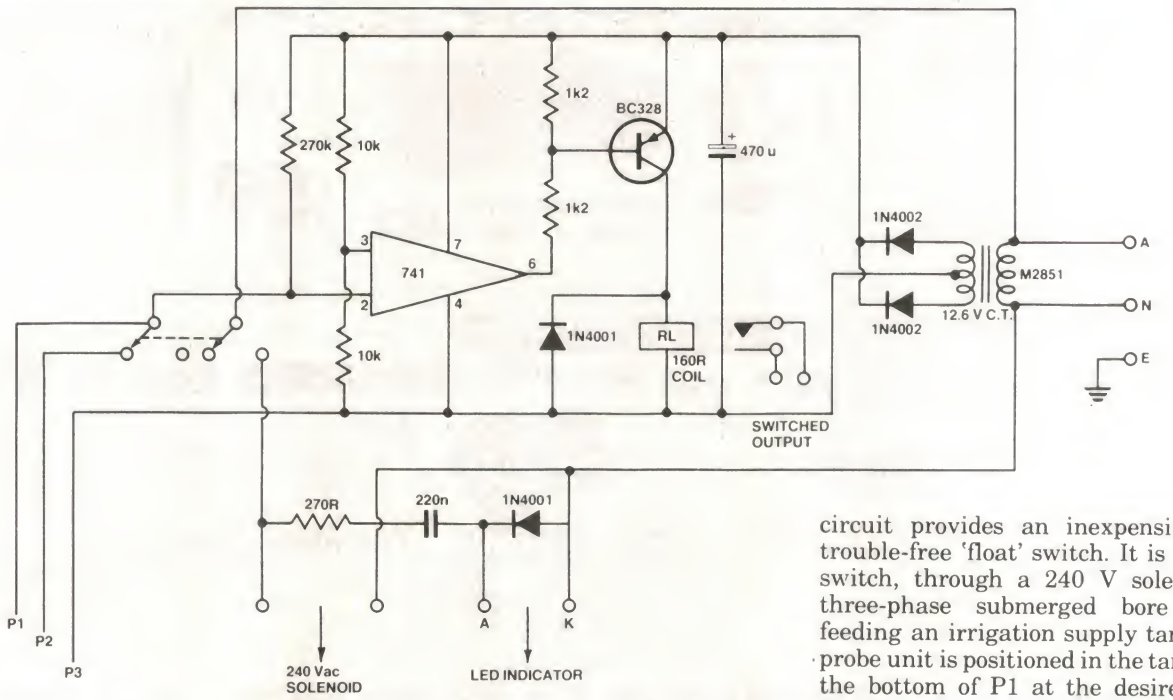
1190 CANTERBURY RD, **PUNCHBOWL 2196** NEAR ROSELANDS SHOPPING CENTRE

TRADING HOURS MON-FRI: 9:00AM-5:30PM SAT: 8:30AM-5:00PM

Fast Mail Orders PACK/POST: ADD 10% ORDER VALUE

Ideas for Experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.



Water level sensor and switch

Here's a novel idea with a practical application, from **F.L. Harrison of Ardross in West Australia.**

It is a water level sensor that controls a pump which maintains the water level in a tank. Three 'sensor' wires are employed: one at the 'high' water level (P1), one at the 'low' water level (P2), and one well below the latter (P3) so that it's permanently in the water. Here's what it's all about.

Using an inexpensive 741 IC and a relay with two sets of contacts, the circuit provides an inexpensive and trouble-free 'float' switch. It is used to switch, through a 240 V solenoid, a three-phase submerged bore pump feeding an irrigation supply tank. The probe unit is positioned in the tank with the bottom of P1 at the desired 'full' level.

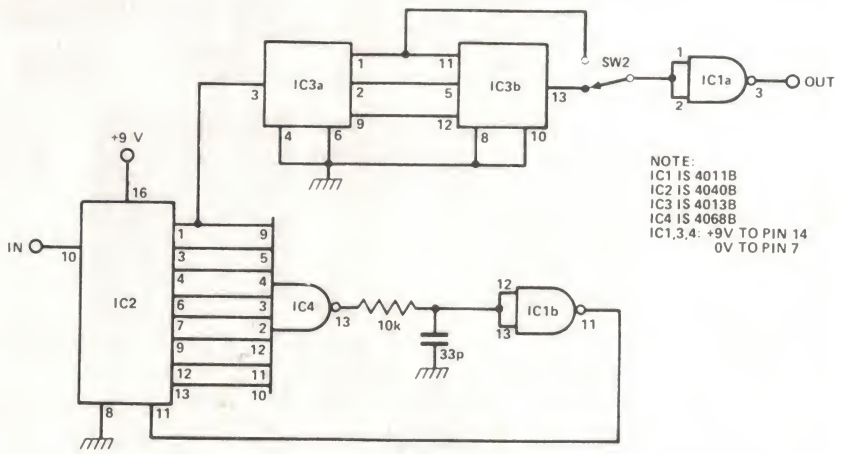
The bore pump does not start until the water level falls below P2 and is not switched off again until the water level reaches P1. This ensures that the supply tank always remains full. The LED, which is remotely mounted, gives a visual indication of when the pump is running.

ETI-606 tuning fork mods

With a few slight modifications to the ETI-606 Tuning Fork (Nov. 1979) it is possible to use the very cheap and plentiful TV colour crystal tuned to 4.43361875 MHz, according to **M.L. Duncan of Greenford, UK.**

The oscillator circuit output is divided by 2519, giving a frequency of 1760 accurate to one part in 250 000. The division is done by a 4040 in place of the 4020 and the switching giving an alternate 'A' at 445 Hz is eliminated.

A 4013 dual flip-flop is added before the output buffer to give further division by two and four. These outputs are switched before the buffer to give a choice of 'A's at 880 and 440 Hz respectively. The extra cost of the 4013 is offset by eliminating one of the 4011s.



The diagram shows the altered parts of the circuit. The oscillator is retained, using the changed crystal, as is the output circuit from R4 onwards.

"HELLSAPOPPIN" AT SHERIDAN'S

WOW! THEY'RE CRAZY!!!

"THE WAR IS ON — JUST LOOK AT THESE PRICES!!

SAVE—SAVE

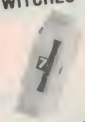
WE'VE GONE BANANAS

SEMICONDUCTORS AT WHOLESALE PRICES . . . JUST COMPARE

		10+	100+
BC 547	NPN 45v 100mA 500mW	9c	7c
BC 557	PNP 45v 100mA 500mW	9c	7c
TIP29B	NPN Power 80v 1A 30W	35c	30c
2N3656	NPN 25v 50mA 200mW	10c	8c
5mm	Red LED's	8c	6c
BZX83C12V	12V 250mW Zener Diode	10c	7c
BZX96C4V7	4.7V 1.5W	30c	25c
ITTRD7B	7.1V 1.1W	25c	20c
NEC ZD	5.6V 200mW	10c	8c
ZX12	12V 15W Zener Diode	.95c	.80c
CD4001AE	CMOS I.C.	15c	12c
2114	450NS Static RAM	2.00	1.80
2114	200NS	2.50	2.30
4116	200NS Dynamic	2.00	1.80
2708	450NS Eprom	4.00	3.70
2716	450NS	4.80	4.30
2532	450NS	10.00	9.00

NEW SHIPMENT OF BRITISH MADE THUMBWHEEL SWITCHES

B.C.D. Type
Size 28 × 12mm
Black Moulding

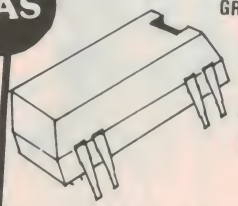


1 Pole 10 pos. type
Size 58 × 12mm
Grey Moulding

Prices either type 1 to 9 **$2.25** ea. 10 plus **$2.00** ea.
100 plus **$1.60** ea.

END PLATES AVAILABLE FOR EITHER TYPE **50¢** PAIR

ELECTROTHERMAL MINI-DIP DUAL-IN-LINE REED RELAYS TYPE GR108A2

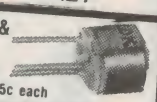


Specs.
SPST 12vdc
Coil Resistance. 1100 ohms
Nom. Current. 11mA
Pull-in Voltage. 8Vdc
Contact rating. 500mA

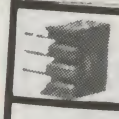
ONLY $1 each
10+, 90c
100+, 80c

CRAZY CRAZY CRAZY

CLEARANCE OF TOP GRADE & QUALITY MINI POT's



Allen-Bradley 1Kohm Single Turn in a T05 Transistor Case **Five for $2.00 or 10× 35c each**



BOURNES 50Kohms Single Turn Cermet Trimpots
Type 3386 .5W rating ¾" sq.
Five for $2.00 or 10+ 35c each.

CLEARANCE SPECIAL

DPDT PCB or Solder Spill PUSH-BUTTON SWITCHES. Complete with RED KNOBS

AT A MAD PRICE OF ONLY 40c each or 10 for $3.50

WHERE ELSE BUT AT SHERIDAN's

BULL TO SO-CALLED "DIRECT IMPORT" PRICES — JUST CHECK OURS

CONNECTORS AT "GIVE-AWAY" PRICES

TOP QUALITY BNC CABLE PLUGS, **$1.50** ea.
10+ **$1.35** ea.

"DEE" TYPE CONNECTORS (UK or USA Mftd.)

25 pin Plug, $3.90.
25 pin Socket, $5.50.
Plastic Cover, $3.00, or $12.00 complete Set
9 pin Plug, Socket & Cover, $6.00.
15 pin Plug, Socket & Cover, $8.00.
37 pin Plug, Socket & Cover, $15.00

bankcard welcome here

NEW DIGITAL SENSATION

SOAR L.C.D. FULLY AUTORANGING D.V.M's.
Three types to choose from

	ME533	ME532	ME531	
DCV	1000	1000	1000	Max
ACV	600	600	600	Max
DCA	200mA	200mA	10A	Max
ACA	200mA	200mA	10A	Max
Res	2Mohms	2Mohms	2Mohms	Max
In-built		Cont. Buzzer	Cont. Buzzer	
In-built			Diode Test	
Price	**$49.95**	**$59.95**	**$79.95**	

THE CHEAPEST AND BEST D.V.M. IN AUSTRALIA FULLY GUARANTEED

OVERLOAD PROTECTION . Battery Life 300hrs approx. Full Specs. available on request

WHY PAY THRU YOUR NOSE for AUDIO LEADS?

forget about so called "DIRECT IMPORT" prices & check ours first

BEST VALUE EVER!!

PART NO.	DESCRIPTION	PRICE EACH
A	5 PIN DIN PLUG TO 5 PIN DIN PLUG	$1.00
B	5 PIN DIN PLUG TO PHONO SOCKET	.45
C	2 x 3.5 PLUGS TO PHONO SOCKET	.45
D	3.5MM PLUG TO 2 ALLIGATOR CLIPS	.70
E	5 PIN DIN PLUG TO 2 ALLIGATOR CLIPS	.80
F	5 PIN DIN PLUG TO 4 x 6.5MM PLUGS	.75
H	3.5MM PLUG TO RCA SOCKET	.40
I	6.5 PLUG TO 2 x 6.5MM SOCKETS	.50
J	3.5MM PLUG TO BARE ENDS	.25
K	5 PIN DIN PLUG TO 3.5MM PLUG	.50
L	STEREO HEADPHONE COILED EXT. LEAD	$1.00
M	5 PIN DIN PLUG TO 4 x RCA PLUGS	$1.00
N	3.5MM PLUG TO 3.5MM PLUG	.40
O	ADAPTOR — 3.5MM PLUG TO 2.5MM PLUG	.20
P	ADAPTOR — 3.5MM SKT. TO RCA SKT.	.20

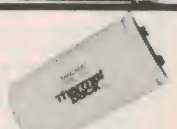
PLEASE ADD SUFFICIENT FOR POST & PKG.

WE ARE OVERSTOCKED WITH CAPACITORS . . . SO OUT THEY GO AT BELOW COST

PHILIPS POLYESTER AXIAL LEADS			10+	100+
.001µf	400V		15c	12c
.0012"	400V		15c	12c
.01µf	160V		12c	10c
.012	160		12c	10c
.027	160		13c	11c
.039	160		13c	11c
.039	400		16c	13c
.18	400		18c	15c
.33	160		16c	13c
.68	160		16c	13c
.82	160		18c	15c
RADIAL TYPES				
.01	630	Blue Cap	25c	22c
.39	100	Red Cap	20c	16c
.1	400	AEE Miniprint	30c	25c
.01	500	Disc Ceramic	15c	12c
470pf	3kV	Disc Ceramic	25c	22c
150µf	6V	Union Carbide Solid Tantalum	$2	$1.80
453pf	400V	1% Silver Mica (ITT)	16c	15c

WE'RE LOSING OUT (SOB-SOB) SO PLEASE DO NOT FORGET TO ADD POSTAL CHARGES—TA.!!

MORE SANGAMO COMPUTER GRADE ELECTROLYTIC CAPACITORS. THE BEST THERE IS AT THE CHEAPEST PRICE.



Cap. Mfd.	Volts	Dia mm	Height mm	Price	P & P
4,200	100	35	85	$6.50	1.00
10,000	25	50	110	$6.00	1.25
9,100	60	50	110	$8.50	1.25

HOW DO THEY DO IT?

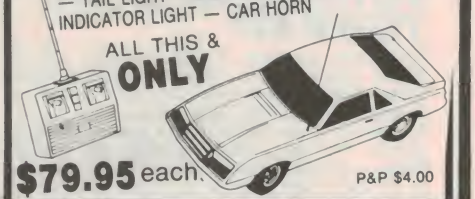
JUST RIGHT FOR CHRISTMAS

REMOTE CONTROL SUPER SPEED CARS

2 models to choose from
MUSTANG MODEL 2800
MERCEDES MODEL 450SLC

Each has 11 Functions with these outstanding features
VARIABLE SPEED — FORWARD — BACKWARD — STOP — TURN LEFT — TURN RIGHT — HEADLIGHT — TAIL LIGHT — LEFT INDICATOR LIGHT — RIGHT INDICATOR LIGHT — CAR HORN

ALL THIS & **ONLY**



$79.95 each. P&P $4.00

SHERIDAN ELECTRONICS

164-166 REDFERN ST, REDFERN, NSW 2016
TELE: 699 5922/699 6912. P.O. BOX 156, REDFERN

GET REAL SATISFACTION!

build a DICK SMITH KIT

they look so good your friends will never believe you built them!

Why build from a kit?

For the best reason: you'll save a fortune! You supply the labour, instead of paying for a production line (and the Managing Director's Ferrari). You can save 50% and more by building it yourself.

Can I do it?

Let's answer that one by asking you a question: can you read and follow simple instructions? If the answer is yes, then you can build our kits: most come with our exclusive step-by-step instructions. You can't go wrong!

Dick Smith's money-back offer.

We're confident you'll be delighted with our kits. But if you're not (for any reason at all — even the fact that you might think construction is beyond you) you can return any kit to us in original condition and packaging (that is, before construction has commenced) and we'll refund your purchase price in full. What could be fairer than that?

Exclusive 'Sorry Dick It Doesn't Work' Guarantee.

On our major kits, we even include a repair service: if for some reason you kit fails to work, we will diagnose the faults and repair them for a lower than normal fixed service fee. This includes any parts you may have damaged during assembly.

So you cannot fail with a Dick Smith Kit!

OUR MOST POPULAR KIT!

PLAYMASTER STEREO MOSFET AMPLIFIER

This 'Top of the Line' amplifier with huge 50W per channel output, has everything you'll ever need in an amplifier. Features include: LED indicated input, Loudness control, Muting control, Full speaker switching facility, Stereo/Mono switching, Tape monitor switch. And with its professionally designed front panel, this amplifier looks as good as it sounds! Complete with comprehensive instructions.

Cat. K-3515 **$132**

PLAYMASTER AM/FM TUNER KIT

This tuner combines a digital readout AM/FM stereo receiver with a quartz controlled digital clock. The kit comes with a fully built, tested and aligned tuner module. With the tuner off, the unit becomes a digital clock with an easy to read LED display. This same display indicates the received frequency in either AM or FM mode when the tuner is in use. Also included are Signal and Tuning meters to help you pull in those weak stations. FM stereo is indicated by an LED. The completed unit is designed to complement the Equaliser.

Cat. K-3494 **$145**

PLAYMASTER STEREO GRAPHIC EQUALIZER

This unit gives you the tonal flexibility and control of a professional equalizer in a kit. With cut and boost of up to 13dB per section, you can use it to make up for audio deficiencies in your listening area, or even create special effects. Look at these specifications: Frequency Response: EQ OUT: flat, EQ IN, 10Hz to 10kHz; Distortion (wrt 1Vrms): @ 100Hz: 93dB, @ 1kHz: 74dB, @ 10kHz: 55dB. This equalizer is designed to complement the Playmaster Mk II Amplifier and the Playmaster Tuner with the same brushed aluminium front panel.

DON'T PAY $350 BUILD IT YOURSELF

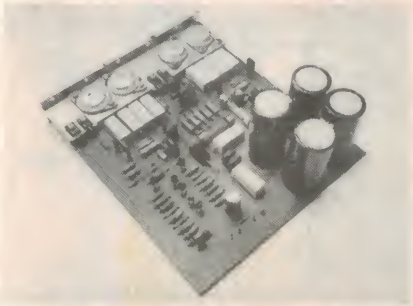
Cat. K-3500 **$99.50**

300 WATT AMPLIFIER MODULE

This kit has the scope for boosting the output of your existing sound system. One module produces 300W RMS into 4 ohms or two modules give you 600W RMS continuous power. These kits are easily suited for mounting in the standard rack mounting case either singely, or in pairs. You will require a transformer (Cat. M-0150) and one or two heatsinks, depending on light or heavy use (Cat. H-3426). Complete with all other components and instructions.

MORE QUALITY DICK SMITH KITS

Everything you need is supplied even nuts & bolts



Cat. K-3444 **$72**

100 WATT AMPLIFIER MODULE

The ultimate in simplicity, even the power transistors mount on the one printed circuit board. PCB heatsink bracket is supplied with the silkscreen overlay on our fibreglass heavy duty PCB. This design is based on the ETI 422 power amplifier but without the power transistor wiring hassles. Features on-board fuse protection and input sensitivity. To be used with power supply (Cat. K-3438).

Cat. K-3442 **$25**

50 WATT AMPLIFIER MODULE

Same design, same simplicity as the 100W Amplifier Module with the added economy of two units able to be run from one power supply (Cat. K-3438). The compact design makes this module an obvious choice for a medium power, general purpose amplifier. Supplied with instruction booklet and fibreglass PCB with silkscreened component overlay for easy assembly. Heatsink bracket is supplied, heatsink is extra.

Cat. K-3440 . **$19.95**

POWER SUPPLY

Full PCB and component kit for one (K-3442) or two (K-3440) modules. Supplied complete with speaker de-thump relay and Zener regulated pre-amp rails. Assembly instructions supplied.

NOTE: Transformer extra

Cat. K-3438 **$19.95**

MIXER PREAMP

This is the ideal mixer, adaptable for your requirements. Designed to suit the 300W amplifier kit, this mixer preamp provides 4 inputs, the input amplifiers having an input of 100K which is suitable for most microphones, guitars, etc. It is also suitable for use with the 50W (K-3440) and 100W (K-3442) power amp modules. This unit also provides bass, treble and presence controls plus a master volume control. Comes complete with all components and instructions.

NOTE: Power transformer, case and mains wiring are not supplied so that the unit can be mounted to suit individual applications.

Cat. K-3035 **$29.50**

MUSICOLOR IV

A new design that combines all the features of Musicolor III and Light Chaser plus much more. Chaser plus 4 chase patterns plus automatic and reverse modes for startling effects. 4 channel Musicolor adds a new dimension to sound — light! Built-in microphone allows any sound to trigger the Musicolor. Comes with sturdy chassis, and exclusive Dick Smith front panel with LED display. Detailed step by step instructions are supplied.

Cat. K-3143 **$91.50**

LIGHT CHASER

This chaser design not only makes the lights chase each other, it can also invert the action and make the 'shadows' chase each other. Or it can reverse the direction. Or invert and reverse automatically, and you can vary the flash rate to suit the particular application.

Cat. K-3145 **$71.50**

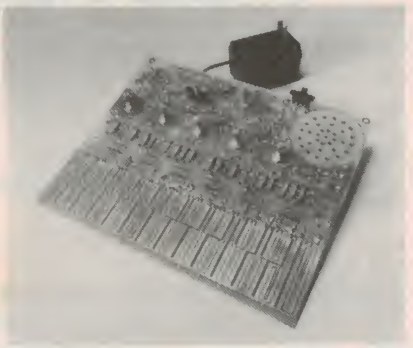
DISCO-STROBE

This includes a special printed circuit board, with provision for a second tube if required. Also includes a 180mm photographic type reflector, which is specially modified so that the perspex safety guard which is supplied, can easily be fitted. Special new instructions are also supplied. A timing control allows flash rate to be varied between one and twenty flashes per second.

Cat. K-3152 **$26.50**

ELECTROCHUNE

The Electrochune is a keyless monophonic organ and uses the circuitry of a synthesizer to give variable attack/decay times, tremolo and square/-sine wave output mixing. It even has a built-in amplifier and speaker with separate volume control. Complete with plugpack and full instructions.



Cat. K-3506 **$69.90**

TV MASTHEAD AMPLIFIER

Improve your TV reception with this easy-to-build kit. Cut out 'snow effect' in low signal areas and reduce 'ghosting' caused by multiple signals or signal pickup from feeder cabling. Also works well in picking up distant stations. This kit is power by the 12V power

MORE QUALITY DICK SMITH KITS

Ideas for Experimenters

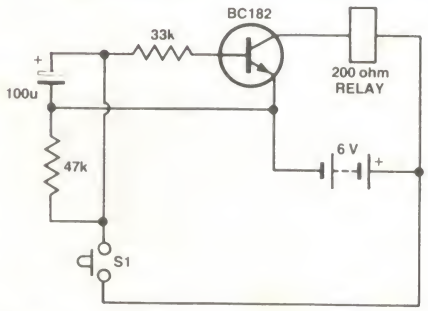
Simple timer

This simple little timer features a minimum of components, most of which can be found in any well-stocked hobbyist's junkbox, and you can fudge a variety of delays by trial and error substitution of components. The idea comes from **David Hughes of Howrah, Tasmania**.

It works as follows. When you press S1 (an ordinary pushbutton) the 100u electrolytic capacitor rapidly charges up. When it gets to about 0.7 V the transistor will be forward biased and collector current will flow, in turn operating the relay. When you release S1, the capacitor will begin to discharge via the 33k resistor and the base of the transistor. When the voltage across the capacitor gets down to half a volt or so the transistor base will no longer be forward biased, collector current will cease and the relay will drop out. The capacitor will continue to discharge via the 47k resistor.

With the values shown, the relay will remain operated for about eight seconds or so. It is advisable to use either a tantalum or a low leakage (RBLL) electrolytic capacitor.

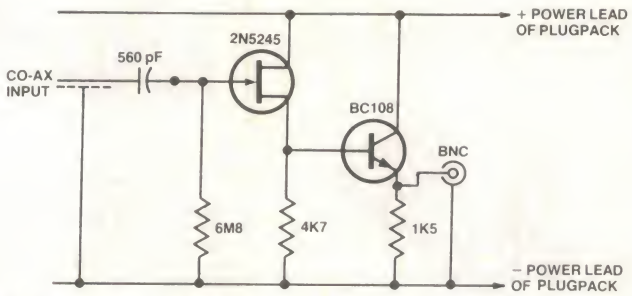
You can fudge things a little to obtain increased times by simply increasing the value of the electrolytic capacitor. Decreasing the value will shorten the period.



You can get quite long times with lower values of capacitance by substituting a Darlington pair for the BC182. In this case you can increase the two resistor values into the megohm range.

Video buffer for the ZX80

When **J.L. Elkhorne of Chigwell, Tasmania,** became the proud possessor of a brand new ZX80, he didn't want to disturb the family's TV viewing by commandeering the TV set as the ZX80's VDU. Having a 230 mm (9") monochrome monitor on hand, the circuit here was developed to press it into service.



Nothing critical exists in the circuit; all values were determined empirically. Transistor type substitutions could probably be made without problems. The bias for the BC108 is provided by the dc coupling to the source of the 2N5245. In the prototype, the drop across the 4k7 resistor was about two volts.

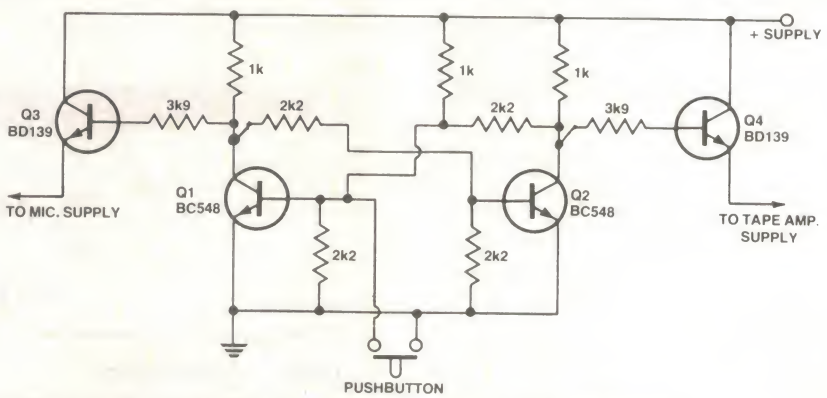
The circuit was built on a tiny piece of Veroboard and put in a small plastic box on hand. The plugpack used with the ZX80 supplied the power. In keeping with a personal policy of minimal changes to commercial hardware, the only internal change to the ZX80 itself was tacking the 560 pF capacitor on the video lead into the on-board modulator. The free end was proteced with sleeving and protrudes out the back slot by the card edge connector.

The centre conductor of a length of miniature coax clips onto the capacitor. The flex of the plugpack was cut and the buffer board used to reconnect it, thus deriving power for nothing. A BNC connector mounted on the plastic box completed this small project.

Solid state audio switch

The purpose of this circuit is to switch off a music source (from a tape amp in this case) and turn on a microphone. **G.B. Wolfe of Bombala, NSW,** wanted to do it electronically, without messy, intervening cables, and this is how he did it.

The pushbutton on the microphone stand is pressed into service to operate the solid-state switch. When operated (i.e: when you want to switch the music off and switch the mic in), the pushbutton shorts the base of Q1 to 0 V. Q1 turns off and Q2 turns on. This turns Q4 off, and as it is in series with the positive supply rail to the music source (tape amp), then the music source turns off. At the same time, Q3 turns on and provides positive supply to the mic preamp.



When the pushbutton is open, Q1 is biased on and Q2/Q3 biased off. Thus only Q4 will be biased on and the music source will be operating.

This way, there is no need to alter the signal circuits and the only change required is to the supply rails; control is by a single-pair lead.

Kit includes detailed instructions

supply, which is included. Also ideal as an FM radio booster too. Instructions included.

Cat. K-3232 **$33.50**

TRANSISTOR TESTER

Not just another Transistor Tester! This one tests bipolar transistors, F.E.T.s, diodes and even S.C.R.s and P.U.T.s. This practical, low cost test instrument is simple enough to be built by a beginner and then provide him with a valuable piece of test equipment. Ideal for the beginner and serviceman alike. Battery operated and supplied with one of our large 50mm meters in a 'Zippy' box with a deluxe front panel.

Cat. K-3052 **$19.75**

TV CRO ADAPTOR

This TV CRO Adaptor is an economical alternative to a conventional CRO. It converts any standard TV set into a large screen oscilloscope with a frequency response from 10Hz to 300kHz with a sensitivity of 100mV RMS for full screen deflection. Gives a good display at low frequencies which makes it ideal for all audio and Hi-Fi applications. This adaptor could also be used as a dramatic display for large audiences such as universities, schools, etc., or even a monitor for stereo systems.

Cat. K-3060 **$23.95**

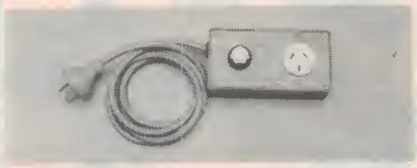
DUAL TRACE CRO SWITCH

Convert your single trace oscilloscope to a dual trace with this money saver. Dual trace CROs have uses in almost every application. In fact, whenever you need to to compare two waveforms, the dual trace CRO is the best answer. Bandwidth is DC to 1MHz, AC 10Hz to 1MHz and Input Impedance is 100k shunted with 30pF.

Cat. K-3065 **$59.50**

DRILL SPEED CONTROL

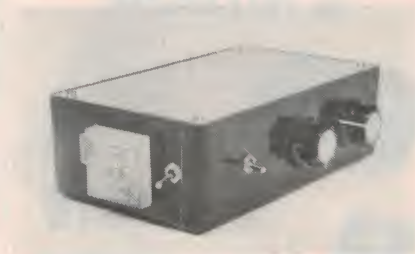
This unit enables your drill to be slowed down to drill large holes in metal or even to be used as a screwdriver. Circuitry gives good torque at very low speeds. Suitable for most 240V 'universal' brush-type motors, up to 3A rating. The kit is supplied complete, down to the last nut and bolt, and that includes the mains cord/plug and output socket. Assembly instructions provided.



Cat. K-3080 **$13.95**

METAL DETECTOR

An induction balance detector which is the equivalent of detectors that cost hundreds of dollars. All electronic components, meter, box, coil wire etc. is supplied, all you supply is some dowel for the shaft and a former for the coil and you're ready to find your fortune!



Cat. K-3100 **$36.50**

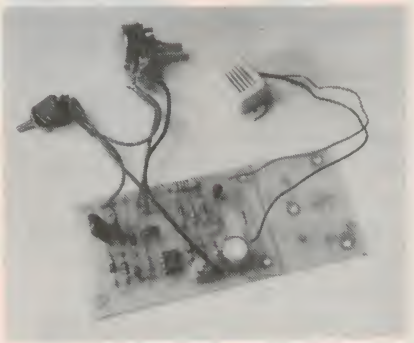
LED TACHOMETER KIT

This kit enables you to get the best from your car's engine. Displays engine speed in analogue form in an illuminated row of LEDS. This form of display indicates your engines performance at a glance. Used with 12V positive or negative earthed systems and only 3 connections are required for installation. Complete instructions supplied.

Cat. K-3240 **$24.50**

SPEED SENTRY

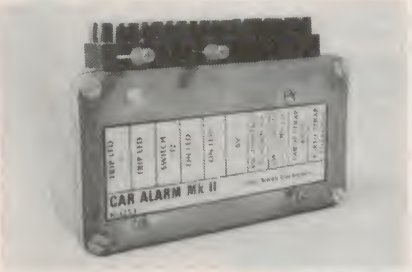
Speed Sentry is an aid to better driving. An alarm will sound (or switch a warning light) when a preset speed is reached. Trigger speed is set by the driver, or at the flick of a switch, a pre-set speed may be monitored.



Cat. K-3245 **$12.75**

CAR ALARM

This alarm works on the principle of detecting voltage drop anywhere in the vehicle's electrical system caused, for example, by the interior light coming on when a door is opened, the brake pedal pressing to energise the stop lights, starting the engine, turning the headlights on, etc. It is very easy to install as it simply connects to a point which is normally 'live' at all times e.g. clock or starter solenoid. Facility is also provided for the alarm to be triggered if an external triggering point is earthed, such as the bonnet or boot opening, detection by way of a mercury tilt switch. This alarm includes an LED which flashes once per second when the alarm is set.



Cat. K-3253 **$28.50**

CAPACITOR DISCHARGE IGNITION KIT

All cars with conventional 'Kettering' ignition systems can be fitted with this simple, easy-to-build kit. The kind of results you can expect from using this kit are: Plugs and points last up to 10 times longer, engine stays in tune much longer, vehicle is much easier to start, even on cold, wet mornings. It also simply disconnects back to your standard ignition.

MORE QUALITY DICK SMITH KITS

Only top quality components used

Cat. K-3280 **$33.50**

CORE BALANCE RELAY

This kit could save your life and protect your equipment. The Core Balance Relay electronically detects earth fault currents and then trips a relay which cuts the power. The relay cannot be reset until the fault has been corrected. Designed to run to 240V, this unit is portable and built into a tough moulded plastic case. Comes complete with special front label.

Cat. K-3315 **$52**

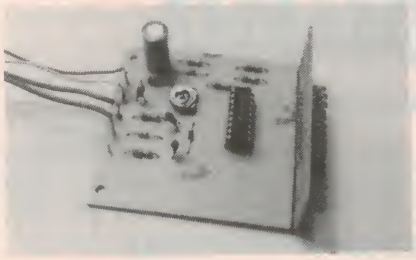
NEGATIVE ION GENERATOR

You've heard about Negative Ion Generators and their benefits, now you can buy the kit and build one yourself. This kit runs on 12V which means that it may be used in your car, as well as making it safer to use. Also includes exclusive Dick Smith emitter head, power pack and tough moulded plastic case. Full instructions supplied.

Cat. K-3335 **$38.50**

LED LEVEL METER

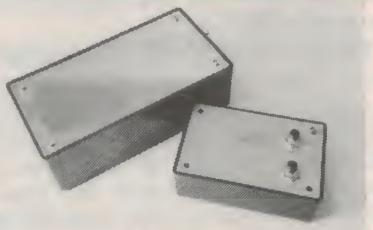
This unit will display the sum of the peak channel output voltages (power), or use two for separate stereo readouts. Readout power level is displayed by 10 green light emitting diodes, one yellow indicating maximum power and red for overload. Full solid-state circuitry, all components mount on a small printed circuit board with the display conveniently attached at right angles for easy mounting of the finished unit. Simple power supply requirement of 10V-16V or DC at 50mA.



Cat. K-3370 **$14.95**

INFRARED LIGHT BEAM RELAY

This light beam trigger uses an invisible beam of light which makes it ideal for burglar alarms, photographic triggering, etc. Depending on conditions, this unit has a range of up to 5m and there are no lenses to adjust. Battery power gives the unit around 50 hours of continuous operation.



Cat. K-3375 **$38.50**

2 CHANNEL INFRARED REMOTE CONTROL

An inexpensive 2 channel remote control with a range of 20m and will control 2 appliances independently. Use it to control your alarms, stereo, radio, in fact just about anything you can think of. The transmitter is battery powered and enclosed in a small 'zippy' box whilst the receiver is mains powered and housed in a handsome metal instrument case (undrilled).

Cat. K-3380 **$65.95**

DIGITAL CLOCK/ THERMOMETER

This kit gives you all the features of a digital alarm clock as well as a digital thermometer. The thermometer will display in either Fahrenheit or Celsius and the clock will even turn your radio on for you. Fitted with an alarm (speaker included) and snooze button, the clock is mains powered with battery back-up. No case is included with this kit.

Cat. K-3436 **$49.50**

LEDS AND LADDERS

Based on the old 'Snakes and Ladders' game, we've replaced snakes with LEDs! This kit has been updated with new circuitry and simplified controls so the whole family can enjoy playing. Complete kit includes front panel sticker and 'zippy' box.

Cat. K-3390 **$16.50**

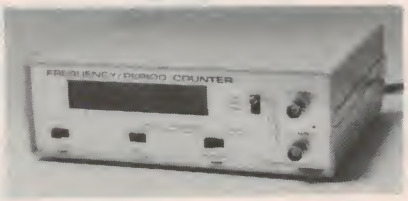
LOTTO/POOLS SELECTOR

This miniature electronic marvel could help you to your first million! Push button, with large LED display makes it easy. Supplied with an attractive front label. Good luck!

Cat. K-3392 **$19.95**

DIGITAL FREQUENCY/ PERIOD COUNTER

(500MHz with optional prescaler) Not only a frequency meter, but also a period counter for accurate high resolution, low frequency measurements. Based on a design by Electronics Australia DEC 81, this professional class instrument rivals the features of fully built up units many times the price.



MORE QUALITY DICK SMITH KITS

Shoparound

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project — check with our advertisers if it is not mentioned here.

ETI-824/825 slot car controllers

As these units use common components in general, you should experience little difficulty in obtaining parts. The 723 regulator used in the ETI-824 is a stock item almost everywhere. The same goes for the semiconductors in the ETI-825. We have not produced panel artwork for either project as we expect most constructors will house the projects to suit their own requirements, thus Scotchcal panels will not be available.

We used different cases on the two ETI-825 prototypes. That shown on the front cover employs an Amtex case, type Amtex 20. These are distributed by Amtex, P.O. Box 285 Chatswood 2067, (02)411-1323. According to Amtex, Radio Despatch Service and David Reid Electronics in Sydney have stocked this case, so check them if you can't find it locally. The other case we used is a Vero case having a sloping front panel and measuring 220 mm wide by 155 mm deep by 100 mm high. It comes in two parts — one light grey, the other dark grey. These are available from Warburton Franki outlets.

Slot cars? See your local toy store, department store, newsagent or hobby shop! You can even find them at the local markets (we bought several $15 sets from a stall at Paddy's Market in Sydney).

So far as we are aware, All Electronic Components and Rod Irving Electronics in Melbourne will be stocking kits.

ETI-159 10-15 V meter

This project also uses commonly-available components and constructors should have little difficulty obtaining parts. The pc board has been designed so that it can be secured to the connecting terminals on the rear of any of the common panel meters so you can use a meter of your choice.

Multiturn trimpots are reasonably common, so you should be able to locate the right ones for this project without too much difficulty.

ETI-685 2650 S100 computer

This project is stocked as a complete kit by Applied Technology ($209). They are also able to supply the pc board, 82S123 ROM and a manual for $80. This is for those constructors with an existing 2650 system who wish to go S100 or those with most of the chips on hand. If you want to make your own pc board (which we don't recommend) patterns are available from us as detailed in the article — but you'll have to work out your own ROM software. Multibug and Binbug monitor ROMs are also available through Applied Technology.

ETI-158 Low Ohms Meter

Constructors looking for kit suppliers of this project, published last month, should try the following firms: In Melbourne, All Electronic Components and Rod Irving Electronics. In Sydney, Electronic Agencies. Note that Radio Despatch Service is able to supply all the parts, including the Scotchcal panel and meter scale.

ETI-660 Learners' Micro

This already popular project is stocked in kit form by the following firms (so far as we can determine at time of going to press): In Sydney, Electronic Agencies and J.R. Components (mail order — P.O. Box 128 Eastwood NSW 2122); All Electronic Components and Rod Irving Electronics in Melbourne plus Kit Parts (Aust) mail order (Private Bag, Noosa Heads Qld 4567).

LM394s

This dual-transistor IC has been specified for the ETI-329 Vehicle Ammeter (Feb.), ETI-330 Car Alarm (July) and ETI-478MC preamp (Sept.) from our Series 5000 Stereo Control Preamp. Earlier in the year, supplies were plentiful. Wouldn't you know it — LM394s are now scarcer than the proverbial hen's teeth. National Semiconductor in the US advise they currently have a manufacturing problem and are quoting lead times in excess of three months. Sorry folks, but this is a problem over which we have no control, nor could we reasonably forsee it. We are investigating possible alternatives and will keep you posted.

If you're in desperate straits, try Dick Smith's store at Coburg in Melbourne or Altronics in Perth. Then again, you could try LM194s — the mil-spec. version . . . at around ten times the price, and you may have to buy a minimum quantity. Ask a National Semiconductors distributor.

LM396 regulators

These aren't your 'bog standard' regulator . . . yet, but the following shops should be able to sell you the odd one:

Radio Despatch Service
869 George St
Sydney NSW 2000

Radio Parts
1103 Dandenong Rd
East Malvern Vic. 3145

Tasman Electronics
12 Victoria St
Coburg Vic. 3058

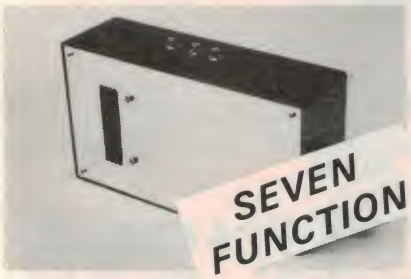
Our kits look so good your friends won't believe you built them.

Cat. K-3439 **$99.50**

Case extra. **$19.95** Cat. H-2505

UNIVERSAL TIMER/ STOPWATCH

All-purpose counter that can be used as a stopwatch, countdown timer or event timer. Large, bright 4 digit LED display and selectable timing rates between 0.01 and 1.0 secs make this timer ideal for sporting events or even darkrooms, wherever keeping accurate time is important. Wiring the unit for any of seven different functions is also possible.



Cat. K-3435 **$39.50**

STEREO BOOSTER AMP

An easy-to-build kit which can economically upgrade the power of your car's stereo radio or cassette to 12.5W RMS per channel. Fitted with a bypass switch for comparison purposes and works with all negative earth electrical systems.

Cat. K-3493 **$29.50**

13.8V 6 AMP PEAK POWER SUPPLY

5 Amps continuous and 6 Amps peak (depending on heatsinks used). This kit includes the M-2000 heavy duty transformer, circuit board and electronic components. This kit does not include case or heatsinks.

Not Illustrated

Cat. K-3449 **$35.50**

VIDEO MODULATOR KIT

This RF Modulator Kit uses only one transistor. The unit is enclosed in a small tinplate box to minimise radiation and all components are mounted on a small printed circuit board. A simple and very useful kit.

Cat. K-3462 **$4.75**

LOW DISTORTION AUDIO OSCILLATOR

This Audio Oscillator uses the characteristic low noise of a VMOS device to give an ultra-low distortion output. All the components mount on a single printed circuit board and construction is very straightforward. This kit comes in a sturdy chassis with black perspex front panel, silkscreened with white lettering. LED power indicator also acts as a dial marker.

Cat. K-3467 **$67**

SHORT WAVE ANTENNA KIT

Get the best possible reception from your shortwave receiver with this kit. Specially designed for Dick Smith by an expert in short wave receivers. This kit comes complete and ready to build and needs no soldering.

Not Illustrated

Cat. K-3490 **$9.95**

SOUND LEVEL METER

This unit will measure noise in its many forms. Measures levels of less than 20dB to levels greater than 120dB with fast or slow response times. This allows you to measure peak or average levels. A large VU meter gives easy readings and the meter range is selectable in 9 steps. The kit is mounted in a 'zippy' box and is battery powered.

Cat. K-3476 **$35.50**

BENCHMATE

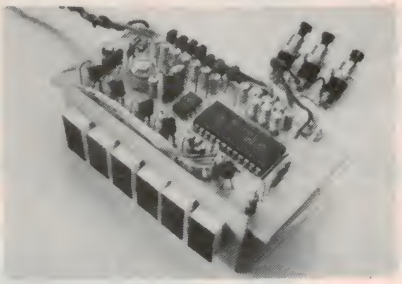
A handy piece of equipment for the test bench. The Benchmate is a regulated power supply, variable between 1.25V and 16V at currents of up to 1A. It also doubles as a audio amplifier capable of delivering a little over 1W rms. The kit comes complete with a sturdy metal instrument case (undrilled), transformer and all the parts and instructions you need, plus a self-adhesive front label for that professional finishing touch.

Cat. K-3478 **$46**

6 DIGIT 12V CLOCK

This extremely easy-to-build clock kit ideal for cars, boats, aircraft, etc. Bright red LED digital readout, large 8mm high, and chronometer accuracy, quartz crystal controlled, this is the only clock kit with seconds display. This kit operates from any 9-19V DC source; use a simple power supply or plug pack for 240V DC operation. Highly detailed instructions included.

Power supply to suit (Cat. M-9514)

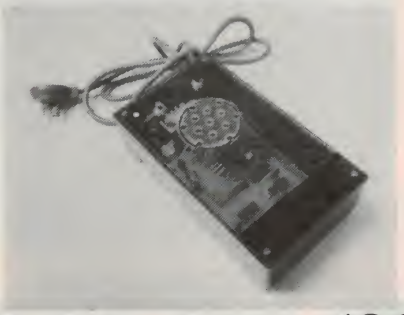


Cat. K-3495 **$19.75**

AUTOCHIME

Autochime is an electronic door chime kit based on the latest microprocessor technology. An exclusive design, this unit plays one of 24 different tunes every time you press the front door button. Perhaps you like one tune in particular, this is also possible. This kit contains all parts necessary to built the project.

NOTE: Front panel is supplied undrilled.



Cat. K-3502 **$31**

MORE QUALITY DICK SMITH KITS

The project you've been waiting for...

The Dick Smith/Electronics Australia

SUPER 80 COMPUTER KIT

build - it - yourself computer

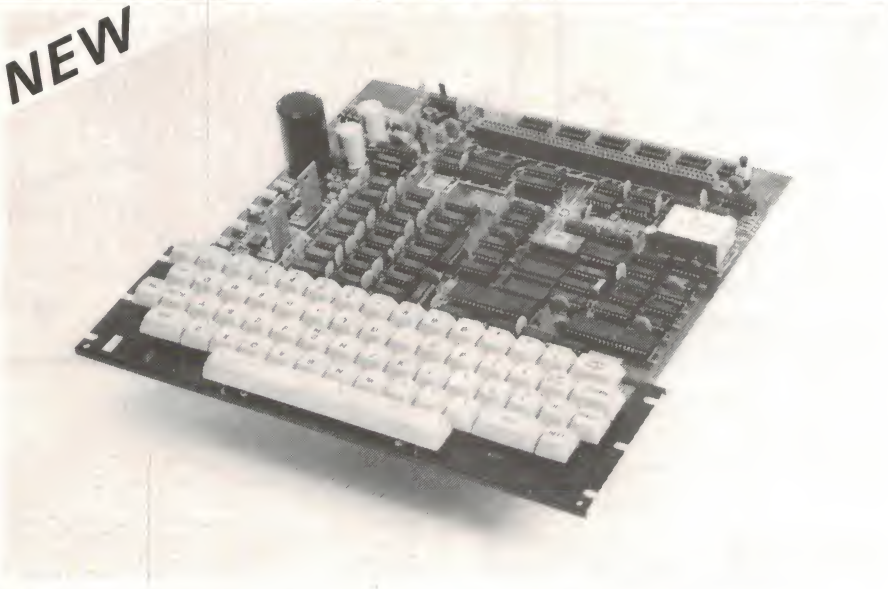
Imagine telling your friends that you actually built your own computer!

Now you can with this superb new kit. Not only do you end up with a powerful working computer, you learn so much about computer technology and operation while you are building it.
It's the ideal way to start learning about this fascinating branch of electronics.

Features:

- Full size professional keyboard
- Supplied on board memory of 16K, expansion to 48K RAM.
- Budget tape 'BASIC' or optional EPROM BASIC
- Cassette interface on board
- Video Modulator on board (works with any TV set)

NEW



- All components on board except power transformer
- S-100 expansion system for add - ons

Options:

Transformer M-2325	**$23.00**
BASIC interpreter on tape K-3602	**$24.50**
IC socket set (recommended) K-3603	**$12.50**
BASIC in Eprom K-3604	**$99.50**

Supplied with re-print of EA article.

- Combined large Assembly & Technical manual B-3600 **$12.50.**
- 'Super Basic Reference Manual B-3602 **$14.50**

BASIC KIT ONLY $295
K-3600

PLAYMASTER SPEAKER KITS

Dick Smith offers you 3 systems to suit your needs, all are acoustically designed by Neville Williams, M.I.R.E.E. (Aust), Editor-in-chief of Electronics Australia magazine and manufactured under meticulous qualtiy control to the exact Electronics Australia specifications.

- Three high-quality speakers (woofer, midrange, tweeter) in each enclosure.
- Beautiful speaker cabinets feature wipe clean vinyl finish - authentic timber appearance.
- Full instructions make it easy - your friends will never believe you built them.
- Wiring harness comes complete with clip-on connections - no soldering required.
- Super value - save hundreds of dollars on speaker systems of equivalent performance.

SPECIAL OFFER: ONE THIRD OFF!

200mm	250mm	300mm
NORMALLY	**NORMALLY**	**NORMALLY**
SPEAKER KIT C-2046 $89.50	**SPEAKER KIT** C-2044 $149.00	**SPEAKER KIT** C-2042 $175.00
BOX KIT C-2626 $82.00	**BOX KIT** C-2624 $115.00	**BOX KIT** C-2622 $139.00
TOTAL: $171.50	**TOTAL:** $264.00	**TOTAL:** $314.00
NOW	**NOW**	**NOW**
$114.33	**$176.00**	**$209.33**

ALL KIT PRICES PER PAIR

SPECIAL OFFER CLOSES 31st DEC.

DICK SMITH Electronics

SHOPS OPEN 9AM to 5.30PM (Saturday: 9am till 12 noon) BRISBANE: Half hour earlier. ANY TERMS OFFERED ARE TO APPROVED APPLICANTS ONLY

VISA

NSW	145 Parramatta Rd	AUBURN	648 0558
	T55 Terrace Level	BANKSTOWN SQ	
	613 Princes Hwy	BLAKEHURST	546 7744
	818 George St	BROADWAY	211 3777
	531 Pittwater Rd	BROOKVALE	93 0441
	147 Hume Hwy	CHULLORA	642 8922
	162 Pacific Hwy	GORE HILL	439 5311
	396 Lane Cove Rd	NORTH RYDE	888 3200
	30 Grose St	PARRAMATTA	683 1133
	125 York St	SYDNEY	290 3377
	173 Maitland Rd	TIGHES HILL	61 1896
	263 Keira St	WOLLONGONG	28 3800
ACT	96 Gladstone St	FYSHWICK	80 4944
QLD	166 Logan Rd	BURANDA	391 6233
	842 Gympie Rd	CHERMSIDE	59 6255
SA	60 Wright St	ADELAIDE	212 1962
	Cnr Main Sth Rd & Flagstaff Rd	DARLINGTON	298 8977
	435 Main North Rd	ENFIELD	260 6088
VIC	399 Lonsdale St	MELBOURNE	67 9834
	260 Sydney Rd	COBURG	383 4455
	656 Bridge Rd	RICHMOND	428 1614
	Cnr Dandenong & Springvale Rds	SPRINGVALE	547 0522
WA	Cnr Wharf St & Albany Hwy	CANNINGTON	451 8666
	414 William St	PERTH	328 6944

Mail Order Centre:
PO Box 321, North Ryde 2113 Phone (02) 888 3200

DSE/A089/LM

JENSEN ELECTRONICS for Japanese ICs and Transistors

TRANSISTORS

	$ c
2SA	
101	1 15
235	2 10
240	1 90
473	2 00
489	4 30
493	1 35
495	75
495G Y	1 10
496Y	1 60
505	1 65
509	1 40
539	1 20
561	1 80
562	85
564A	1 40
608	1 50
628A	65
634	1 95
636	4 50
639	1 15
640	1 15
641	1 15
642	1 30
661	1 35
670	2 45
671	2 55
673	70
678	1 75
682 O	2 40
683	1 15
684	1 35
697	2 10
706	4 20
715	1 90
719Q	90
720	1 15
726	1 55
733P O	70
740	7 60
748	3 00
758	8 65
769	3 90
794	2 45
816	1 90
844C	75
844D	75
885	2 15
950	3 00
969	6 30
999	65
1015Y	85
2SB	
56	80
77	95
156	1 90
187	1 00
324	95
337	4 50
364	1 50
405	1 35
407	4 20
415	1 10
434	3 65
440	2 10
449	4 80
463	3 60
471	4 80
474	3 15
492	2 40
504	16 60
506	21 60

TRANSISTORS

	$
2SB	
509	6 30
511	2 20
512	4 60
514	2 55
525C	1 45
529	1 70
534	2 20
536A	3 25
536B	3 85
541	9 60
544	1 10
549	3 35
554	16 80
555	15 00
557	12 95
562	1 80
596	3 65
617	6 00
618A	9 00
647A	2 00
688	6 00
764	1 20
2SC	
281	1 90
371	75
372Y	70
373	60
374	75
380	65
381Y	90
382	1 70
383	1 50
385A	1 45
387A	1 45
388A	1 15
398Y	2 30
399	2 15
403C	1 30
454L	50
458B C	60
460	55
461	95
485	5 50
494	9 30
495Y	1 60
496	3 70
498	3 60
509Y	1 75
535A	70
536D	50
538A	1 50
562	1 95
563	1 95
605	2 35
620C D	65
641	1 30
643A	8 65
644	70
681	7 90
685	3 00
693	55
710C	80
710D	80
711A E	55
712C	70
717	2 00
728	2 75
730	9 90
731	15 35
732	65
733	65

TRANSISTORS

	$
2SC	
734	90
735Y O	1 00
738	75
756	7 30
761	1 90
762	1 90
763D	80
776	9 40
780	1 95
781	6 50
782	11 20
783	6 75
784R	2 50
785	85
789	3 85
790	2 95
791	7 00
792	6 75
793	6 30
799	6 25
815	90
828A	90
828O P	90
829B C	75
838H	85
839F H	60
871E	80
900E	70
900F	70
900U	70
901A	7 80
926	1 35
929	65
930	65
933	1 40
935	8 45
940L	6 40
941	1 20
943	2 30
945A Q R S	70
983	2 65
1000GR	1 10
1014C 2	1 65
1014D	1 65
1017	1 75
1018	3 80
1024	3 65
1047	75
1060	1 70
1061A B C	1 60
1061D	1 60
1070	2 95
1096	1 40
1098	1 95
1106	9 40
1124	2 90
1162	1 15
1172B	18 60
1173	1 70
1175	85
1210	70
1213	80
1214	1 90
1215	70
1222	70
1226A	1 25
1239	9 70
1260	6 40
1306	6 55
1307	7 85
1317	75
1318R	90

TRANSISTORS

	$ c
2SC	
1327T	70
1328	1 20
1335	1 15
1344	75
1346	1 50
1359	90
1360	1 05
1362	1 70
1363	1 15
1364	90
1368	1 75
1383R	1 30
1384Q R	1 45
1393	1 60
1398	1 90
1419	2 45
1446	2 00
1447	3 95
1448	3 70
1449	2 75
1450	5 50
1475	1 90
1506K L M	1 55
1507K L M	1 55
1509	2 60
1550	1 95
1567	2 35
1568	2 35
1569	4 00
1571	65
1583	2 10
1589	5 30
1591	39 70
1620	19 80
1647	70
1674	70
1675L	70
1678	3 75
1683	3 10
1685	75
1687	95
1688	1 15
1740	2 90
1760	3 20
1775E	1 15
1810	5 85
1815GR	1 00
1815Y	1 00
1816	5 40
1827	3 90
1845	1 50
1846R	1 40
1848	1 95
1856	1 20
1906	1 75
1908	95
1909	7 50
1923R	85
1942	12 90
1945	14 00
1947	15 85
1957	1 35
1964	3 55
1967	26 60
1968A	39 65
1969C H	6 90
1973	1 85
2053	3 15
2055	3 15
2073	2 85
2074	2 00
2075	4 95

TRANSISTORS

	$ c
2SC	
2076	70
2086	1 05
2098	10 00
2099	26 90
2116	4 45
2131	9 20
2132	68 25
2146	4 55
2152	35 60
2166	3 65
2229	1 65
2233	4 35
2274	85
2320	65
2327	9 80
2724	70
2SD	
30	1 30
91	8 10
93	8 40
111Y	10 50
113Y	26 10
180	5 95
187R	1 35
200	6 30
213	20 50
227	2 50
234	1 90
235Y	2 25
288	2 00
300	13 90
313E	1 80
315	3 40
318	4 00
325	1 60
330	1 75
350A	9 80
355C	1 05
359	1 80
380	9 70
388	6 30
389	3 60
400	75
415	2 70
424	18 90
426	15 60
467	1 85
471	1 10
525	2 90
526	3 90
586	4 85
587SB	3 65
588A	8 25
667A	2 00
863	1 15
2SK	
19GR	1 45
19Y	1 45
30Y A	1 30
33F	1 40
34E	1 25
40C	1 35
41D	1 05
41F	1 80
42	3 85
44	1 95
49H	1 85
54B	1 05
55D	1 05
55E	1 05

TRANSISTORS

	$ c
2SK	
68 L	1.00
107	1 60
120	1 45
125	3 75
128	1.60
150	3 70
3SK	
37	5 85
39Q R	4 10
40M	5 50
41L	4.95
45R	2 35
48	4 95
51 03	3 20
54B	3 05
59GR	2 90

INTEGRATED CIRCUITS

	$ c
AN	
214	5 25
217	4 10
240	14 70
272	8 10
315	7 95
360E	1 95
612	5 10
6552	2 95
7140	5.75
7151	6.95
BA	
501	9 25
511	9 25
521	9 25
CA	
3012	8 20
DS	
8654N	8 40
FX	
107	33 60
HA	
1156 W	4 05
1199	4 55
1306 W	5 40
1322	6 20
1329	4 75
1338	11 20
1339A	7 40
1342	5 45
1366 W	7 50
1366 WR	7 00
1367	11 40
1397	14 70
LA	
1201	2 90
4102	4 25
4420	4 10
4430	3 80
LM	
386N 1	1 30
M	
5115PR	12 90
5152L	5.15
51202L	3 10
51513L	14 40
58476	29 95

INTEGRATED CIRCUITS

	$ c
MB	
3705	4 80
3756	6.10
MC	
14001	1 85
14001BCP	1 60
14011	.65
14015	2.60
14016B	2.90
14028	1.90
14049	1.35
14066	1.65
14071	85
14076	2.55
14511	3 10
14526B	6.95
14532	3.35
14543	4 30
14568B	12.55
1458	2 90
1496G	2 95
3340	5.65
4044	5.95
4069	1 35
MHW	
710-003	52 00
MM	
5369AA N	5.95
5387AA N	9 80
5799NBR	39 95
74C 93	6 15
MSM	
100RS-8642	4.35
105R 7261	4.35
131R	6.60
153R	14 95
160R 7260	13 15
561	6.40
564	6.40
5107	11 75
5535	6.40
NDC	
40013	15.95
40044	24 80
NIS	
7261A	9 30
NJM	
4558D	2.85
PLL	
02 A	15.85
RC	
4558	2 30
SL	
1626	11 50
1640	8.80
SN	
74161	1.95
74184	9.95
76115	3.65
76600P	5.55
TA	
78	6.55
7045	5.75
7055P	5.85
7060P	2.20
7061P	2.75

INTEGRATED CIRCUITS

	$ c
TA	
7062P	4.70
7063P	2.10
7069P	4.45
7073P	10.25
7089M	7.30
7102P	11.55
7108P	3.85
7120P	1.80
7130P	4.60
7141AP	12.00
7146P	12.00
7203P	9.50
7204P	4.85
7205P	4.55
7215P	12.00
7222AP	6.25
7227P	24.30
7310/C3001AN	4.40
7310/C3001AT	3.35
7310P	2.95
7313P	3.65
TBA	
810 SH	5.00
TC	
4508	11.75
5032P	16.25
5080P	11.80
5081P	8.45
5082P	8.45
9100	13.95

INTEGRATED CIRCUITS

	$ c
TMS	
1943 NL	16.00
uA	
703	3 65
UHIC	
005	9.95
uPC	
78L05	1.75
78L06	1.75
78L062AWC	2 70
78L62WV	2 70
78L08AC	1.75
30C	5.45
41C	5.40
555H	1.60
562C	9.45
566H	1.25
575C2	4 95
576H	7.30
577H	1.60
587C2	6.95
592H2	1.55
1001H2	5.20
1020H	11.50
1025H	6.60
1156H	4.85
1181H	7.85
1182H	7.85
1350H	6.00
uPD	
858C	10.95

INTEGRATED CIRCUITS

	$ c
UP	
477-C12	69 00
Curtis	
8044	24.95

CRYSTALS

	$ c
1.0000 MHz	11 95
3.579545	7 50
7.4015	6.80
7.8015	9 90
9 555	4 80
9.565	4.80
10.000	6.95
10.020	4 50
10.0525	6.35
10.240	6.95
10.245	11.50
10.692	6.95
10.695	6.95
12.800	11.50
16.965	6.20
17.065	6.20
17.115	6.20
17.165	6.20
17.215	6.20
21.145	11.50
32.520	11.50
33.020	11.50
33.520	11.50
35.395	11.50
35.500	11.50
35.552083	11.50

CRYSTALS

	$ c
35.895 MHz	11 50
35.96875	11 50
36.380	11 50
36.395	11 50
37.36875	11 50
37.76875	11 50
39.16875	11 50
40.4875	11.50
40.9875	11.50
41.000	11 50
41.4875	11.95
41.500	11 50
41.9875	11 50
42.000	11.50
42.500	11.50
43.500	11.50
44.000	11.50
50.77666	8.30
50.79666	8.30
50.80666	8.30
50.81666	8.30
50.82666	8.30
50.84666	8.30
50.85666	8.30
50.86666	8.30
50.87666	8.30
52.486666	10.20
52.4966	10.20
52.506666	10.20
52.5166	10.20
52.526666	10.20
52.5366	10.20
52.546666	10.20
52.5566	10.20
52.5666	10.20

FAST MAIL ORDER SERVICE
Enquiries: Phone (08) 269-4744. 2 Lines
Prices subject to change without notice
Minimum pack and postage $1.00
TRADE ENQUIRIES WELCOME

JENSEN ELECTRONICS
75 Prospect Road, Prospect, SA 5082
Phone (08) 269-4744

Please send:

Quantity	Part Number	each $	each c	Total $	Total c

ORDER TOTAL $
Plus $1.50 post/pack
PAYMENT ATTACHED$

Bankcard No

Signature

Name

Address

Pcode

CHRISTMAS SPECIAL - 25% OFF!

(WHILE STOCKS LAST)

ARRL PUBLICATIONS

Now you can order a selection of popular and useful publications put out by The American Radio Relay League, direct from ETI by mail order.

A COURSE IN RADIO FUNDAMENTALS

Written by the world-renowned author, George Grammer, this book is recommended reading for anyone studying for their amateur licence, be it Novice, Limited or Full. In fact, it's a very good reference text for any enthusiastic hobbyist. The book contains 26 chapters, covering a considerable amount of basic theory from electric and magnetic fields to ac and dc circuits, resistance, reactance, transformers, RF circuits, filters, etc, to vacuum tubes and transistors, amplification, feedback and amplifier circuits. A chapter on practical experiments is included and each chapter has associated problems to work out (answers given).

180 pages $5.25 ~~$7.00~~

SOLID STATE BASICS

An essential book for everyone who wants to understand solid state circuits and how to design them. This book takes you from simple solid state theory to transistor circuit design. Then follows an introduction to linear and digital ICs and how to work with them. It's crammed with practical circuits designed using the techniques discussed.

160 pages $5.05 ~~$6.75~~

ARRL WORLD MAP

This is a modified equidistant azimuthal projection map showing all areas of the world with political boundaries, call areas, IARU continental subdivisions, ITU regional boundaries, world time zones and cities. A valuable addition to any shack.

1020 x 780 mm $5.05 ~~$6.75~~

Please send me (tick as applicable):

- ☐ A Course in Radio Fundamentals
- ☐ Solid State Design for the Radio Amateur
- ☐ Learning to Work with Integrated Circuits
- ☐ Solid State Basics
- ☐ ARRL Antenna Anthology
- ☐ ARRL Antenna Book
- ☐ ARRL Electronics Data Book
- ☐ Basic Book of Ham Radio
- ☐ ARRL World Map

I enclose $ ..... plus 90¢ per book postage and packing (Australia only). Please allow up to four weeks for delivery.

TOTAL $ .....

NAME .....

ADDRESS .....

.....

.....Postcode .....

Signature .....

Send coupon to: ETI Book Sales, 15 Boundary St, Rushcutters Bay NSW 2011.

LEARNING TO WORK WITH INTEGRATED CIRCUITS

An invaluable book for the beginner or newcomer to digital circuitry. In nine chapters Jerry Hall and Charles Watts take you through the basics of commonly used linear and digital ICs, binary arithmetic and counting, frequency counters and digital voltmeters — and show you how to build a frequency counter/DVM as you go along! Written in a clear, easy-to-follow style; complete construction details, pc board artwork, etc, are included.

50 pages $2.80 ~~$3.75~~

ARRL ANTENNA ANTHOLOGY

This book is a compilation of the best of recent HF antenna articles and theory presentations published in QST magazine. Its five chapters cover Vertical Antennas, Yagi Antennas, Quad Antennas, Miscellaneous Antenna Types and Antenna Theory and Test Methods. Construction of more than 30 antennas is described along with a range of matching networks and systems.

152 pages $5.25 ~~$7.00~~

ARRL ANTENNA BOOK

A basic reference text that should be in every enthusiast's and amateur's library. In 18 chapters, this book covers such topics as Wave Propagation, Transmission Lines, Long-Wire Antennas, Multiband Antennas, VHF/UHF Antennas, Rotatable Antennas, Specialised Antennas and Antenna Measurements. It is a comprehensive text chock-full of tables, charts and construction information.

336 pages $6.55 ~~$8.75~~

ARRL ELECTRONICS DATA BOOK

A must for every electronics enthusiast's or radio amateur's bookshelf. Its 10 chapters cover Math Aids and Tables, Time and Frequency, RF Circuit Data, LCR Networks, Transformers, Filter Design, Antennas and Feed Systems, Catalogue of Solid State Circuits, Constructions and Testing Data, Data Potpourri. How could you do without it?

128 pages $5.05 ~~$6.75~~

BASIC BOOK OF HAM RADIO

A basic guide of what the hobby's all about. Though written for the American scene, the theme is universal. Ten chapters tell it all, from what hams do to a guide to the equipment, how to get on the air to how to speak the jargon.

128 pages $5.80 ~~$7.75~~

SOLID STATE DESIGN FOR THE RADIO AMATEUR

Written as a series for QST, this book is an anthology of the work of Wes Hayward and Doug DeMaw — two world-renowned technical authors. The Collins Radio Division of Rockwell regard this book as recommended reading for their junior engineers. Considered generally as a landmark text, it is just the thing for those interested in actually building high performance equipment, as it contains practical information not found elsewhere in sources available to the professional or non-professional. In nine chapters, the book covers Semiconductors and the Amateur, Basics of Transmitter Design, Power Amplifiers and Matching Networks, Receiver Design, Test Equipment, Modulation Methods and Portable Gear, etc. An extensive and very handy bibliography is included.

258 chock-full pages $9.00 ~~$12.00~~

COMMUNICATIONS

OSCAR 9 flies!

The long-awaited, oft delayed UOSAT spacecraft was launched from the US Vandenburg Air Force Base at 1127Z October 6 in what was described as a 'perfect launch'.

The orbit is circular, the craft being at an altitude of around 545 km above ground. Orbital period is close to 95 minutes and the path moves westward at about 24 degrees each successive orbit.

A command problem, involving the 145.825 MHz beacon, arose shortly after launch but was resolved apparently later in October.

The English-built craft is a 'hobbyist and educational' satellite carrying a variety of equipment including a camera for transmission of earth pictures that can be readily received on simple equipment. In addition, it carries a number of phase-referenced HF beacons operating in the 7, 14, 21 and 28 MHz bands for propagation studies and two microwave beacons in the 2.4 and 10 GHz bands. UOSAT also carries a magnetometer and two particle radiation counters.

Oscar 9 has a general data beacon on 145.825 MHz and an engineering data beacon on 435.025 MHz, both of which have been reported received at good strength on simple equipment (handheld and a rubber ducky antenna!).

Amateur regulations handbook

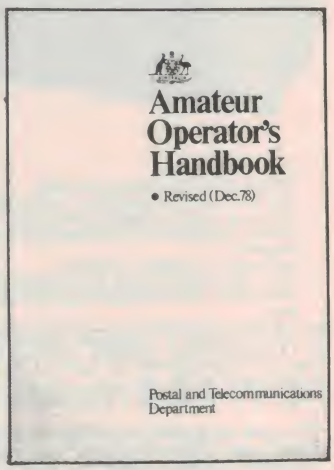
You can now obtain the Department of Communications' Amateur Operator's Handbook through Dick Smith Stores — an item you'll need now if you're going for the exam early next year.

The Amateur Operator's Handbook, Cat.No. B 5042, outlines the regulations and conditions for the operating of Amateur Radio.

About one third of the exam for Amateur Operators' Certificates of Proficiency (AOCP) is based on regulations, and so the B 5042 is essential reading for anyone interested in becoming an amateur operator.

This handbook is the all-new updated version, including changes in the service since the previous version.

The handbook was previously only available from Government Publications, but Dick Smith has made a special purchase as a service to amateurs and aspiring amateurs. Now the Amateur Operator's Handbook is available for $3.60 from all Dick Smith Electronics stores.



Radio-induced changes in ionosphere to be studied

How radio transmissions may alter the ionosphere and thereby disturb long-range communications is being investigated by scientists at the Lockheed Palo Alto Laboratories.

Under a contract with the Office of Naval Research, Lockheed has designed and built a satellite-borne experiment to determine if radio transmissions at very low frequencies will induce electron precipitation from the earth's magnetosphere into its ionosphere.

Such precipitation causes irregularities in the ionosphere, which in turn can interrupt or degrade extremely low frequency (ELF) and very low frequency (VLF) communications.

This phenomenon is of significant interest to the US Navy because of the number of existing and proposed communication systems they operate in these frequency ranges.

Called the Stimulated Emission of Energetic Particles (SEEP) experiment, the programme is a joint effort of Lockheed's Space Sciences Laboratory and the Radio Sciences Laboratory of Stanford University. It follows earlier research conducted by Lockheed for the Office of Naval Research (ONR).

It is known that energetic electrons from the magnetosphere (the region of space in which such particles are controlled by the earth's magnetic field) are naturally injected into the ionosphere near the polar regions.

When the energetic electrons penetrate the ionosphere they give up their energy by ionising its neutral constituents. This injection and ionisation ebbs and flows by natural processes. However, when it increases markedly (for example, when solar activity is high), it degrades or destroys the 'reflecting' properties of the ionosphere and adversely affects radio propagation — notably at long wavelengths.

Lockheed scientists now suspect that this energetic electron precipitation may be caused by specific ground-based radio transmitters.

The SEEP instrumentation system will operate aboard a satellite. The system's detectors will observe electron precipitation while several high-powered, ground-based transmitters at different locations are keyed in an on/off duty cycle that will provide a unique 'signature' in the particles, enabling researchers to establish positively a cause-effect relationship.

Among radio transmissions to be monitored during the experiment are those of the OMEGA network, the US Navy communications system, and the Stanford University research transmitter at Siple, Antarctica. All operate in the VLF range (3 to 30 kHz), which resonates with the natural frequencies of the trapped electrons in the magnetosphere.

SEEP instrumentation consists of high-sensitivity electron spectrometers, a mapping X-ray spectrometer, and an airglow photometer.

The electron spectrometers will directly sample energetic particles which strike them. The mapping X-ray spectrometer will view a much broader area, detecting the particles by the X-radiation they emit as they penetrate the atmosphere and interact with other particle nuclei. The photometer responds to light (airglow) emitted by the atmospheric atoms when they are struck by the precipitating electrons.

AEA agent for coaxial cable

Antenna Engineering Australia Pty Ltd has been appointed agent in Australia for the West German manufactured range of coaxial cables and wave-guides by Kabelmetal.

Low-loss foam dielectric coaxial cables cover 6 mm to 41 mm diameter, and air dielectric cables available are from 9.5 mm to 230 mm diameter. AEA is currently stocking 13 mm and 22 mm low-loss foam coaxial cable and matching connectors.

Kabelmetal also produce a wide range of elliptical wave guides and components and rectangular wave guide components.

Radiating RF cables for restricted communication systems are available, together with all necessary installation components.

Kabelmetal products are manufactured in Hannover, West Germany, and by associated companies in the USA and Brazil.

For further information contact Antenna Engineering Australia Pty Ltd, P.O. Box 191, Croydon Vic. 3136.

ELEGANT SIMPLICITY ▸ MOSFET TECHNOLOGY

Advances in technology should make life simpler. A cluttered power amplifier board may well perform superbly, but its busy elaboration is an indication that its design is pushing the limit of its component technology.
There are many first class bipolar amps on the market. All of them are complex and consequently expensive. Any additional improvements in the areas where they are weak (i.e. H.F. distortion) can only be obtained with yet further complexity and cost.
Only new technology can provide the sort of "quantum jump" in component performance necessary to reduce the clutter on the board, reduce the cost and make the Highest Fidelity a reality.
So far 29 semiconductor manufacturers have invested in MOSFET technology. Clearly power MOSFETs are something special.
The enormous power gain of the MOSFET helps eliminate conventional drive circuitry permitting delightfully simple designs viz. the 5000.
Their freedom from secondary breakdown and tendency to shutdown when thermally overstressed results in inherently destruction-proof output stages, not needing protection circuitry. Remember if your bipolar amp is D.C. coupled the only thing between your speaker and lethal supply rails is that bipolar power transistor! Back to MOSFETs.
Perhaps best of all, the MOSFETs lack of charge storage makes them FAST, FAST, FAST and RESPONSIVE. MOSFET transistors produce amps, that have wide bandwidth, low distortion even at high frequencies and – very important – high slew rate.
If you are a perfectionist or are just not happy with what you have got now this system could be for you. You owe it to yourself once in a lifetime to bestow upon yourself "the best". In the case of amplifiers, this is it.

A CHRISTMAS PRESENT PERHAPS?

5000 POWER AMPLIFIER

PERHAPS THE PERFECT REALISATION OF THE CLASSIC POWERFET AMP DESIGN.

The Jaycar kit of this project is being continuously updated in quality so that the constructor will benefit. We now supply metal film 1% 50ppm resistors in place of carbon film types. All Aluminium hardware (including heatsink bracket) is now anodised in black. (Incidentally there has never been a problem with instability with Jaycar kits. We have ALWAYS used high quality capacitors).
The original square-section chassis bars are used. And then there is the Superfinish frontpanel!

Specifications: Power Output – 100 watts r.m.s. into 8 ohms x2 Frequency Response – 8Hz to 20kHz, +0 –0.4dB. Noise – 116dB below full output. Input Sensitivity – 1V r.m.s. for 100 watt output. For full specifications see magazine article on this amplifier.

Ref: ETI Jan – April 1981

EXCLUSIVE!!!
- Metal film 1% resistors used
- All Aluminium panels now anodised
- Original dsign chassis bars used
- Heavy gauge extruded section heatsink bracket
- prewound output chokes
- Flux shorting straps on transformers
- And then there's the Superfinish heatsink

$289 +

5000 CONTROL PREAMP

Control being the operative word. With this preamp you are in TOTAL CONTROL.
With 3 x phono inputs and 5 OTHER input facilities, you can dub to TWO (2) tape decks – say one cassette and one reel-to-reel. Once again we have used 1% 50ppm metal film resistors throughout – even where not specified by Dave Tillbrook.
For further information see the specifications summary below:

Frequency Response – 15Hz 130kHz @ +0, –1dB. Distortion 1kHz - 0.003% on all inputs. S/N Ratio – high level input 92 dB, MM input 86dB, MC input 71dB. For other specs see mag.

EXCLUSIVE!!!
- English "Lorlin" switches used
- Metalwork exactly as per project
- description
- Special Nylon grommets used to insulate jacks
- Metal film 1% resistors used
- Specially imported solid Aluminium knobs
- FREE! Pair of GOLD PLATED RCA chassis sockets for low noise M.C. input

only $245 +

ONLY ✱ ✱ ✱ ✱ $49.50 The Jaycar Front Panel

SUPERFINISH front panel. Special fine grain Aluminium machined, drilled and tapped and finished in special low-gloss black enamel. This panel stands up to a close inspection.

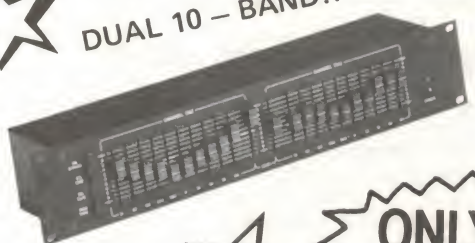
" OR $299 TOTAL WITH THE 5000 POWER AMP"

Parts available separately

ETI485/JAYCAR 2010 EQUALISER NEW MkII model with QUAD-FETs

We have upgraded the performance of this popular kit by taking advantage of the new high technology J-FET input op-amps.
The MkII Stereophonic Equaliser now has a much lower noise floor, better T.I.D. performance due to the higher slew-rate of the J-FETs. Lower harmonic distortion also prevails.

DUAL 10 – BAND!!



+ $5.50 P & P

ONLY $129

FEATURES:
- New low noise J-FETs throughout - replacing Bipolar OP Amps
- Lower noise floor
- Lower harmonic distortion
- Lower transient intermodulation distortion
- Completely new assembly instructions
- Standard 3½" x 19" rack cabinet (prepunched) supplied
- Heavy guage anodised silk screened front panel

1/3 OCTAVE 28 BAND EQUALISER NEW MkII model at NO EXTRA CHARGE!!

We have made the same changes to the 2801 Equaliser but we have absorbed the EXTRA COST! Professional style bright yellow slider covers are now standard also.

+ $5.50 P & P **still only $198**

Jaycar

NOTE! NEW SHOP HOURS
Mon - Sat 9am – 5.30pm
Sun - 10am – 2pm
Open Thursday night until 8pm.

380 Sussex St Sydney 2000
Ph. 2646688 Telex 72293
Mail Orders To: Box K-39 Haymarket 2000

JAYCAR – THE POWERFET SPECIALISTS

LETTERS

Dear Sir,

I was one of the first to rush out and buy one of the ETI 466 300 watt amps. Since the first day I built it I've started losing hair!

Having made over 20 kits ' of numerous things, done repairs on my friends' amps and repaired computer cards, (the latter for a living) I thought I'd be up to building this amp.

I was on holidays at the time and I had the amp built in next to no time. When it came to set up the current through the output transistors, I found I could get only 1.5 V across the 10 ohm resistors replacing the fuses and then it quickly increased till the 10 ohm resistors exploded. Thus ended the first lot of power transistors.

Next time I earthed the input the same thing happened, but not so quickly. After I had spent about $80 on output trannies and the complete replacement of all transistors (twice!!) the manager of Dick Smith's at Buranda, Brisbane enquired as to what was going wrong. I explained what was happening and that I'd even gone to the extent of checking each component to see that it was within tolerance. I was in luck! There was a chap up from Dick's head office and he sent it down (the amp) to be fixed by the experts down south. About three weeks later it returned. I managed to get hold of the same gentleman (I forget his name) and he informed me it was going wild at about 2 MHz and that the chaps replaced one of the feedback caps and moved my heatsink earth strap (the amp wasn't mounted in a box yet) and replaced the output transistors again. It was working!

I might add **all** those repairs were done for free and I was very grateful for their assistance. The amp ran perfectly for about six months without fault until it received a short on the output which promptly killed it. I replaced the faulty parts and she was away again!

About two months ago the amp once again failed and I might add at this point the amp does get used for disc jockey work into 4 ohms. My speakers will only handle 100 watts each so I have a power meter set for 200 watts (it was calibrated on a professional amp). The heatsink is a sheet of aluminium 13 x 7 inches with 14 7" x 3" fins fixed to it. This keeps things really cool. Anyway — I carry a 120 watt Auditec amp (these are indestructible!) as back-up so I used it till I had time to look at the 466.

I bought four new output transistors, checked all surrounding BD140s and 139s, and it set up OK. Plugged her in — no worries, away she went, flat chat into distortion, no worries. The next time I had to use it whilst DJ-ing, I ran it for half an hour at about 3 - 5 watts and then I decreased the level (due to the party noise) and bang!, dead again. Back to the back-up amp.

I then took the 466 into work where I have a full workshop except for a CRO. I checked **all** transistors and replaced the faulty ones. I even replaced some of the suspect resistors and diodes. It set up OK so I added two more output transistors (total of 6). I increased the current a little to cover the addition of these and it set up perfectly. I took it home and plugged in one 8 ohm speaker and it promptly blew up. I took it back to work again and practically stripped the board. I replaced every transistor standing. I checked all voltage levels. It set up perfectly again (only four output transistors as replacing six each time is **very** expensive). I even gave it a short test run on a small speaker at work. I took it home and it self destructed again! I then picked up the case which housed both the 300 W and the 120 W Auditec and threw it down the stairs at the front of my house!

Crushed and mangled, I took the remains upstairs and realised the Auditec was also in the mess somewhere. I plugged it in and away went the Auditec as if nothing had happened!

I won't say what I think about the chap who designed this 'novel paperweight' but I have never been so disgusted with anything in all my years. I defy all attempts to reverse it. The only satisfaction I ever got from building it was destroying it.

I know of many other amps which have also met the same fate, because I'm at Dick Smith's store so often I've seen many a frustrated hobbyist bewildered by the 466. All I could tell them is 'pull it apart before it gets you'. If you want to keep hair on the heads of Australian men DON'T GIVE US ANY MORE KITS OR PROJECTS LIKE THIS, EVER!!!

Yours sincerely,
A. Stewart
Gumdale, Qld.

Well, well. You certainly seem to have had the rounds of Murphy's Law, Mother Nature and mayhem on this one! You should have called us the first time. We built three of these projects prior to publication without experiencing the difficulties you report.

The problem, as you found out, stems from high frequency instability. **This is not a fault inherent in either the electronic design or the physical construction,** *as we described in the article (Feb. '80). Let us make that point abundantly clear at the outset. The instability is brought about by components which have different characteristics to those employed in the units we constructed.* **This is something over which we have no control,** *nor was it something we were aware of until after the project was published and kits became available.*

Prime offender was the capacitors supplied for C15. The network on the output consisting of C15 and R47 is there to provide a low impedance load to the amplifier at frequencies beyond the audio range — where speakers and crossover networks look like strange reactances. For this network to do its job, C15 must look like a 'real' capacitor. If, owing to its particular internal construction, it looks like an inductor at the frequencies concerned (above 25 kHz) then that little network will have entirely the opposite effect to that desired. Which is what happened in your case — and many others.

The next culprit (or culprits) we discovered turned out to be the emitter ballast resistors for the output devices. As is evident from the photographs of the pc board included in the article, we used 'Noble' brand resistors. Unbeknown to us, these just happen to be the types having the lowest inductance available. Types supplied with some kits had up to four times the inductance of the ones we used. Result, instability! ▶

LETTERS

When problems became evident following publication we quickly researched what might be causing the problem. We had discussions with Gary Crapp, Service Manager at Dick Smith Electronics, about reported problems with kits supplied by Dick Smith. Following our investigations, we made certain recommendations which we understand were followed and common problems, much of the nature you experienced, rapidly cleared up. Details of our recommendations were circulated to other kit and component suppliers.

In addition, some people were using output devices (MJ15003/MJ15004) which had differing specifications to the Motorola-manufactured devices we used. We recommend the Motorola devices as the protection circuitry was designed around the published Motorola specifications for these devices.

A very large number of these amplifiers have been built and appear to work satisfactorily. It is apparent that you are the victim of circumstances beyond our control. We are indebted to Gary Crapp of Dick Smith Electronics for his cooperation in respect of this project.

To our certain knowledge, other firms supplying this kit have not reported customers experiencing difficulties as you did. Components which do not behave as one would reasonably expect can catch out anyone and the only consolation you, the Dick Smith organisation and anybody else has, is that we have all been in the same boat.

When difficulties like this arise, constructors should make **absolutely certain** *that the components used are as we specify in the project article. We can take no responsibility for substitutions. In any event, you can phone us (after 4.30 pm please) and check with technical staff.*

A similar problem arose with the ETI-477 MOSFET amplifier, published earlier this year. The capacitor in the HF load network on the output, C9, was a source of trouble in some kits, as were the source ballast resistors for the output devices. A note to this effect was published on page 11 of the August '81 issue.

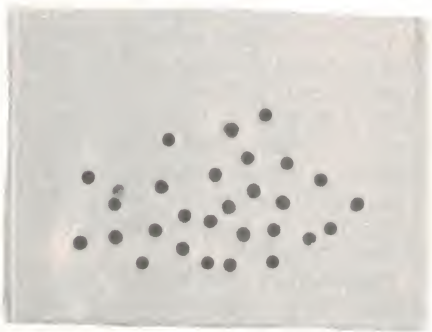
Roger Harrison, Editor

Dear Sir,

Many thanks for solving the *big* problem with my mini-drill which, until now, has been frustrating to use. I constructed the ETI-258 on Veroboard around a 7805, using a scratch-built 0R22, and deleting the rectifier diodes and zener. By substituting a 1000 μF capacitor I was able to get the project into Dick Smith's smallest Zippy box, using the cover as a heatsink. I find 9 volts from my LM317 power supply quite sufficient for most jobs, as the increased torque from the drill is truly remarkable.

I am enclosing an electronic tea-strainer for Roger, as a token of appreciation for publishing Graeme's circuit.

F. Hawkins, Townsville Qld.



Many thanks, Mr. Hawkins, all donations gratefully accepted and usefully applied ... except I rarely drink tea! (R.H.)

UNREPEATABLE OFFER - BUY NOW!

Amazing scoop!

YES we have scooped a further 50 units of the ever popular FT207R

THE LAST 50 IN THE WORLD!

AUTOSCAN
Up or down scanning of full band, with 3-way setting — clear, busy or manual.

DIGITAL DISPLAY
Large easy to read LED readout. Auto turn-off for power saving too!

Specifications:
- 144-148MHz band coverage in 800 channels.
- High and low power (400mW-2.5W)
- 32uV sensitivity — 7.5kHz selectivity
- NiCad battery pack and charger included in price
- External antenna, ear, microphone socket.
- Compact size — 180 x 65 x 55mm
- Rubber Duck antenna included.

800 CHANNELS (4 memory channels)
Instant recall of your 4 favourite repeaters or simplex frequencies. (Easy to read program)

19 key easy to use keypad. For frequency input, memory recall, scanning etc.

Normally ~~$358~~
~~August only at~~ Extended to September by public demand!
$295
Cat. D-2888 P&P $5.50

ALL NEW Yaesu 2 Metre 50W/All Mode Linear amp

Add to hand held above for real mobile power. Also suitable for SSB, CW AM etc. Operates from 13.6V DC up to 15W input for maximum power. Includes 12dB receiver, pre-amp. with automatic transmit receive control.
(above hand held may not drive to full power)

Cat. D-2547
$239
P&P $5.50

EXCLUSIVE: Receiver pre-amp built-in

SPECIAL OFFER

FREE If you purchase a D-4100 base with resonator, we will give a **FREE** 2M stub (D-4102) worth $11.25 at no extra charge.

When you buy the gutter mount base & 2M stub, you're on the air on 2M immediately. As you want the HF bands, simply buy that band resonator/antenna whip & screw it into the 2M stub. You only have to buy the whips for the band you want. Go mobile with Yaesu.

RSE · M · 2 GUTTER MOUNT Cat. D-4100	$24.95	RSL · 7 40M ANTENNA Cat. D-4112	$25.50
RSE · 2A 2M STUB Cat. D-4102	$11.25	RSL · 14 20M ANTENNA Cat. D-4114	$25.50
RSL · 145 6M/2M ANTENNA Cat. D-4104	$27.50	RSL · 21 15M ANTENNA Cat. D-4116	$25.50
RSL · 3.5 80M ANTENNA Cat. D-4110	$25.50	RSL · 28 10M ANTENNA Cat. D-4118	$25.50

MULTI MODE HF t'ceiver small enough for a mini car!

D-2862

The FT707 has to be one of the fastest selling transceivers we've ever had to offer. And it's no wonder! Look at what you get: full power operation, digital display, LED S/power meter, plus push button operation . . . all the things the amateur needs for safe, yet reliable mobile operation. Or why not team it up with the FP707 supply (D-2895), it makes a great base!

ONLY $795.00

REMEMBER: We will match or beat any genuine advertised price!

DICK SMITH Electronics

- AUBURN 648 0558
- BLAKEHURST 546 7744
- BROADWAY 211 3777
- BANKSTOWN SQ. 888 3200
- BROOKVALE 93 8922
- CHULLORA 642 8922
- GORE HILL 439 5311
- PARRAMATTA 683 1133
- SYDNEY 290 3377
- NEWCASTLE 61 1896
- WOLLONGONG 28 3200
- CANBERRA 80 4944
- BURANDA 391 6233
- CHERMSIDE 59 6255
- ADELAIDE 212 1962
- DARLINGTON 298 8977
- ENFIELD 260 6088
- MELBOURNE 67 9834
- RICHMOND 428 1614
- SPRINGVALE 547 0552
- COBURG 383 4455
- PERTH 328 6944
- CANNINGTON 451 8666

welcome here

MAIL ORDER CENTRE: P.O. Box 321 North Ryde, NSW. 2113. Ph. (02) 888 3200

A009 MB

PRICE BREAKTHROUGH

A DAISY WHEEL PRINTER

$995

MICRO-80 has converted the revolutionary new Olivetti Praxis 30 portable electronic DAISY WHEEL typewriter to operate as a correspondence quality printer. Now you can have the best of both worlds. The best auto-correcting portable electronic typewriter available AND a reliable word processing printer for your microcomputer.

Designed for private and light commercial use, the MICRO-80 conversion provides the PRAXIS with an industry standard Centronics printer port which will operate with most microcomputers including the TRS-80TM, the SYSTEM 80TM the SORCERER and the APPLE. Average print speed is 120 words per minute. An RS232C serial to Centronics converter is also available from MICRO-80 to enable the PRAXIS or any other Centronics compatible printer to operate from an RS232C serial port.

MICRO-80 is an A Grade Olivetti distributor and has been producing printer conversions for Olivetti daisy wheel typewriters for 12 months. All typewriters sold by us carry our Australia-wide 90 day parts and labour warranty. If your need is for a larger, heavier duty typewriter/printer, contact us for details of the ET121 or ET221 conversions.

The demand for this great value printer is sure to be high. Use the coupon below to secure your order today.

DEALER ENQUIRIES WELCOME

TM: TRS-80 is a trademark of the Tandy Corporation
SYSTEM-80 is a trademark of Dick Smith Electronics Pty. Ltd.

MICRO-80 433 MORPHETT STREET, ADELAIDE, S.A. 5000
TELEPHONE: (08) 211 7244

Post now to:
MICRO-80 PTY. LTD., P.O. BOX 213, GOODWOOD, S.A. 5034

Please send me:

		TICK
A PRAXIS 30 Typewriter converted to operate as a Centronics compatible printer	$995	☐
An RS 232C to Centronics converter	$140	☐
More details of the above products		☐

I enclose my cheque/money order of $.....
NOTE: Prices above are F.O.B. Adelaide
Please add $10.00 for road freight anywhere in Australia

Please charge to my Bankcard
Bankcard No. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Expiry date: .....

Name: .....

Address: ..... Post Code: .....

COMPUTING TODAY

IBM helps the deaf to speak

Researchers at IBM France are developing visual feedback techniques that help deaf people to modulate their voices normally.

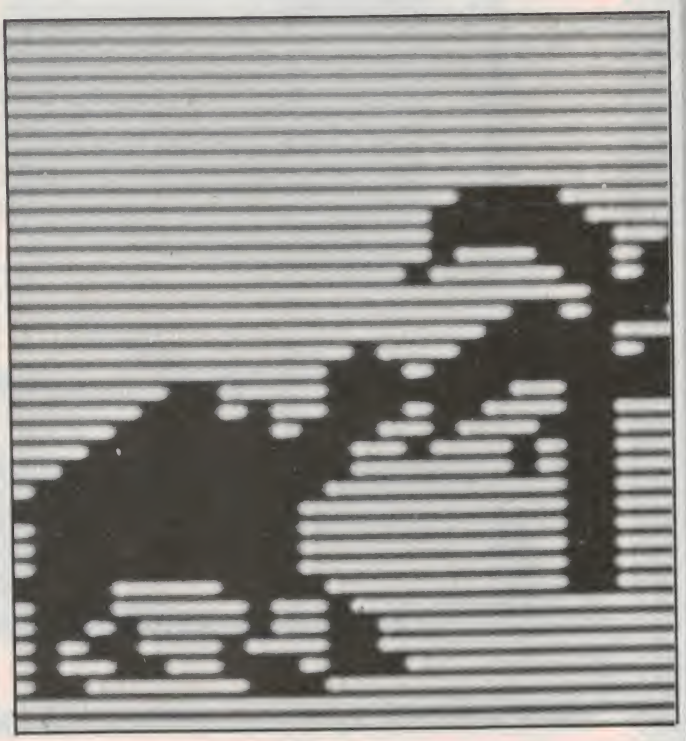
People with normal hearing continually vary the pitch and intensity of their voices as they speak, but those with impaired hearing find it very difficult to do this. Children born deaf, in particular, have never heard a human voice and therefore have no concept of stress or pitch. Without extensive speech training, their voices may become loud or shrill.

At the IBM Scientific Centre in Paris, experimenters have developed a set of games that give deaf children visual feedback about the sound of their voices. A typical game presents a stylised image of a camel on a VDU screen. The camel moves jerkily across the screen according to the sounds made by a child speaking into a microphone. If the child's voice is well-modulated, the camel proceeds smoothly towards an oasis, otherwise it wanders off course and blunders into palm trees.

As well as these 'hit the target' games, the system also allows a teacher to divide the screen horizontally, so that the upper half displays a graph of the teacher's voice and the lower half displays the child's. The child can then see how closely the pitch of his or her voice matches the teacher's.

The system is based on two co-operating microprocessors, one of which analyses the speech while the other controls the input and output devices. An analogue-to-digital converter translates the sounds spoken into a digital code, from which the analysing microprocessor generates signals representing pitch and intensity. These signals are sent to the second microprocessor, which uses them to generate control signals for the VDU.

The researchers are naturally cautious about the results, but they are encouraged by their experiences to date. In one case, for example, a boy with a high-pitched voice succeeded in lowering its pitch after ten sessions with the equipment.



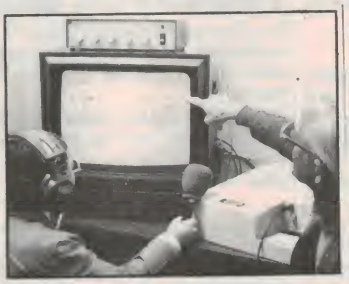
... and to listen

Another project at the same Centre aims to help severely deaf people by applying data processing techniques to lip-reading.

For many purposes, simple lip-reading is not accurate enough, because different sounds often appear the same on the lips. The problem can be overcome by a technique known as cued speech, in which the speaker uses a set of hand signals to indicate vowels or consonants. By moving his hands as he speaks, the speaker clarifies ambiguities for the lip-reader.

The disadvantage of cued speech is that the hand signals must be learned by the speaker. IBM's researchers are trying to eliminate this problem by using a computer to translate the speaker's sounds directly into visual cues. These cues could be displayed, for example, by a set of lights on the frame of a pair of spectacles.

Experiments are now being conducted, using an IBM System



370 Model 145 computer, to improve the accuracy of speech recognition techniques. They hope to train the computer to discriminate reliably between different phonemes (the basic elements of speech). If they succeed, their work could bring a dramatic improvement in communication with deaf people.

Cromemco sales up

Informative Systems Pty Ltd, a Cromemco distributor, has announced a 150% growth in sales for the 1980-81 trading year. Managing Director Dr. Simon Rosenbaum said it was the third successive year in which sales had exceeded 100% growth rate.

The increase was not in any one market area, sales to the education and small business areas being only slightly ahead of purchases for industrial and scientific applications.

To handle increased demand, Informative Systems recently moved to larger premises and more than doubled its systems and support staff. It is at present seeking more staff in the software and technical area, as well as for its new Victorian sales consultancy.

A new Cromemco business accounting system offering multi-terminal, multi-tasking capability has just become available from Informative Systems, and is claimed to be the only Unix-based microcomputer in Australia offering six-terminal capability.

Cromemco systems operating under CROMIX have been coupled with IMS's business software to produce handling power previously only available to the small businessman and professional through bureaux or on much higher-priced minisystems.

The Cromemco-IMS package offers the businessman a totally integrated accounting system covering Accounts Receivable, Accounts Payable, General Ledger, Order Entry/Invoicing, Stock processing and Cromemco's Data Base Management System and Data Base Reporter.

For further information contact Informative Systems Pty Ltd, 337 Moray St. South Melbourne Vic. 3205. (03)690-2899.

The affordable computer!

the brilliant DICK SMITH SYSTEM 80

OVER 4500 SOLD

ONLY $750*

Note: price includes increased Government Sales Tax

Cat. X-4005

Outstanding value for money . . . plus programs especially written for Australia!

Australia's fastest selling computer — and small wonder!

Compare the System 80 with its competitors: you'll see why!

And now it's even better: with new features to make your computing even better.

Join the thousands of System 80 users now: turn yourself into a computer expert!

*Monitor and Expansion Unit optional at extra cost.

REMEMBER: OUR COMPUTER COMES WITH INBUILT CASSETTE & VIDEO MODULATOR: DON'T PAY EXTRA!

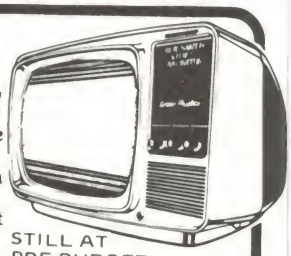
UNLEASH THE FULL POTENTIAL OF YOUR COMPUTER . . .

To get the most from your computer, you need to add peripherals. This expansion unit give you this capability. Made to world standard S-100 system, so you aren't tied to any one supplier for your add-ons.
Cat. X-4010

S-100 EXPANSION
ONLY $499

LOOK AT DICK'S PRICE FOR A GREEN PHOSPHOR MONITOR!

For the professional user — or even the hobbyist who uses his system for long periods, a Green Screen Monitor is a must.
Good definition, with bright, sharp print that can be looked at for hours longer with less fatigue.
Cat. X-1198



STILL AT PRE-BUDGET PRICE!

NOW WITH IN-BUILT AMPLIFIER FOR PROGRAMS WITH SOUND EFFECTS!

$199

NEW!

INTERFACING TO S-100

This book helps S-100 Bus users expand the utility & power of their systems. It describes the S-100 Bus with unmatched precision. Covers such topics as mechanical & functional design, logical & electrical relationships, bus interconnections, & busing techniques. Plus much, much, more. A truly authoritative reference!

WELL WORTH $15.95

B-2341

THE ECONOMICAL ANSWER TO STORING HUGE AMOUNTS OF DATA

THE DICK SMITH DATFILE

Datfile is a flexible, multi-purpose data filing system. It lets you store away on your computer's disk(s) a huge amount of information in virtually any format you want. Whether you're managing a business, running a club, maintaining a big mailing list, keeping records of people, stock or anything else.

ONLY $99.00

X-3760

TO FIND OUT MORE CALL IN & COLLECT A BROCHURE

SAVE $60

& MORE ON THIS DISK DRIVE & POWER SUPPLY PACKAGE!

SAVE $60 ON THIS DISK DRIVE & POWER SUPPLY PACKAGE

SUITS TRS-80 AS WELL AS SYSTEM 80 COMPUTERS!

This time last year we were selling this disk drive and power supply for $439.00. Now we've slashed the price of the pair to only $379.00 - the power supply is thrown in as a bonus!

Hurry: take advantage of this incredible offer. It's the low cost way to get disk storage for YOUR computer. Compare our price and save a bundle!

Features:

- 100K bytes per side storage
- 40 tracks (giving 128% more than Tandy drives)
- Use as first drive or add-on drive (switch selectable)
- Precision made for Dick Smith Electronics

X-3230

DISK DRIVE & POWER SUPPLY

ONLY $379 Including power supply AT NO EXTRA COST!

X-3232

★★★★★★★★★★★★★★★★★★★★

WAS $439 including power supply
NOW SAVING YOU A MASSIVE $60!!

★★★★★★★★★★★★★★★★★★★★

PLUS YOU SAVE PER BYTE ON TANDY!

GREAT NEW SOFTWARE

LUNAR LANDER

One of the most incredibly executed arcade game ever! The program features a real time LUNAR LANDER which you attempt to manoeuvre across a rugged lunar landscape to a safe landing site. With approximately 10 landing sites to choose from, you select the one that suits your skill. Also included in a hidden ravine is a refueling station & for the grand master a special 900 point landing site. Requires 16K, cassette based. Great sound effects! X-3691

SYSTEM 80 & TRS 80 with 16K & Level 11 BASIC.

ONLY $19.50

BETA BLITZ

Put yourself in the pilot seat as you approach the city on a high speed bomb run. Your mission is to destroy the enemy's ground installations. Naturally, they will respond with ground fire and can mount a formidable air attack. Incredibly fast, real time graphics, make this a very exciting package. Cassette based. X-3638

ONLY $14.95

ARRIVING MID DECEMBER!

GALACTIC TRADER

The objective of this fantastic program is to make a fortune by trading commodities throughout the galaxy. Has 10 levels of difficulty. Playing time from 20 min to 5 hours. 16K required, cassette based. X-3678.

ONLY $19.95

GALACTIC EMPIRE

A sophisticated game of strategy & tactics. Your object is to unify the galaxy . Superb graphics & detailed manual supplied. Hours & hours of fun. 16K required, cassette based. X-3679.

ONLY $19.95

GALACTIC REVOLUTION

Diplomacy, social manipulation and ruthlessness must be combined to bring the major power blocs of the Galaxy together to serve your needs to lead the revolution. A fascinating game. 16K required, cassette based. X-3677

ONLY $19.95

METEOR MISSION

The objective of this graphical game is to rescue the stranded astronauts from the planet below. You must manoeuver your craft through the meteor belt. Absolutely brilliant! X-3697.

ONLY $19.50

COSMIC FIGHTER

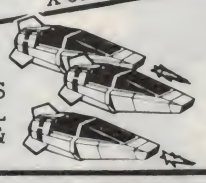
Similar to Space Invaders, but this time alien destruction requires two hits, then three hits . . . it becomes exceedingly difficult and fast. X-3695.

$19.50

GALAXY INVASION

The idea of this game is to destroy the 'invaders' and save Earth - but beware of the roving flagships. Cassette based, requires 16K. X-3693

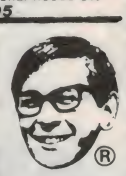
ONLY $19.50



OUR RANGE OF SOFTWARE IS ALWAYS EXPANDING . CALL INTO ANY OF OUR STORES & SEE FOR YOURSELF.

WE NOW STOCK 'POPULAR COMPUTER' *A comprehensive guide to computing that covers business, home, educational needs etc. ONLY $2.95*

DICK SMITH Electronics



DSE A092RB

NSW Auburn 648 0558 — Bankstown Square — Blakehurst 546 7744 — Broadway 211 3777 — Brookvale 93 0441 — Chullora 642 8922 — Gore Hill 439 5311 — North Ryde 888 3200 — Parramatta 683 1133 — Sydney 290 3377 — Tighes Hill 61 1896 — Wollongong 28 3800 **ACT** Fyshwick 80 4944 **QLD** Buranda 391 6233 — Chermside 59 6255 **SA** Adelaide 212 1962 — Darlington 298 8977 — Enfield 260 6088 **VIC** Melbourne 67 9834 — Coburg 383 4455 — Richmond 428 1614 — Springvale 547 0522 **WA** Cannington 451 8666 — Perth 328 6944

Mail Order Centre: PO Box 321, North Ryde 2113. Phone: (02) 888 3200

Print-out

Fluke microsystem troubleshooter

With the population explosion of microprocessor-based circuits in terminals, business machines, minicomputers, peripherals and electronic instruments of all types, a rapidly growing need for a simple and efficient digital service tool has been created. The new Fluke 9010A Microsystem Troubleshooter is said to fulfil that need exactly.

According to Elmeasco Instruments, Fluke's Australian agents, the 9010A will, without writing any test program and regardless of the complexity of the microsystem, troubleshoot the entire 'kernel' (power supply, clock, buss, RAM, ROM, I/O) of the microsystem automatically. Operating through the microprocessor socket, results are posted on a 32-character alphanumeric display.

The design of the 9010A includes an algorithm which automatically examines and defines all signal locations and functions of the microsystem kernel from a working board using its 'learn' mode, storing this data in its own memory for the day's work or on mini-cassette for permanent storage. Thus the toughest and most time consuming failures to troubleshoot, namely failures occurring in buss-connected devices outside the micro itself, may be found by a fast and totally self-contained test program, put to work literally the same day as the instrument is received in a production or service facility.

The 9010A has other testing algorithms for working outside the 'kernel' where peripheral devices such as character generators, keyboards, readouts, print heads, relays and other mechanical or electronic controls reside.

The 9010A's keyboard includes grouped troubleshooting key functions for automatic patterns and digital exercises which are selected directly at the keyboard in an interactive, on-line manner by the operator. No computer expertise or knowledge of programming language is said to be required. High-level software works to provide a few simple keystrokes for the most complex testing functions.

The 9010A also includes a highly versatile troubleshooting probe, which not only counts events, takes signatures and shows logic states, but also injects signals at either a 1 kHz rate or synchronised to the system clock. The probe may be synchronised to data, address or free-run, while an oscilloscope trigger output synchronised with the probe is another convenience item not found in other microsystem testers.

Compact, lightweight and rugged, the 9010A works through a calculator-sized interface 'pod', which in turn connects to the microprocessor socket via a tough ribbon cable. The pod is protected from such common operator abuses as plugging into the microprocessor socket backwards. Several pods are available to match the popular microprocessors, with future capability for a 32-bit device.

The 9010A, including the pod, is priced at no more than the cost of a good scope. Elmeasco anticipate that the 9010A could easily replace the scope as preferred instrument for front-line microprocessor system troubleshooting.

Further information is available from Elmeasco Instruments Pty Ltd, P.O. Box 30, Concord NSW 2137. (02)736-2888.

Spectrum moves into Winchesters

The Australian computer designer and manufacturer D.D. Webster Electronics Pty Ltd has introduced a range of Winchester disk machines at the top end of its large family of Spectrum-II minicomputers.

D.D. Webster Electronics has a product range of over 50 model configurations available, with installation sites now approaching 300.

Two new systems have been released, Spectrum models HC and GC, with a formatted storage capacity of 8.5 M and 30 M respectively. The new models use high performance eight-inch DEC RK07 software-compatible Winchester disks and can comfortably support between ten and fourteen terminals, including a parallel line printer interface. Prices for the new range start at $12 000.

Complete specialised applications currently available with the two larger Spectrums include software packages for accounting, production planning, purchasing, word processing, educational administration and student education.

Since its establishment in 1970, D.D. Webster Electronics has established sales branches in Brisbane and New York, and recently received a $50 000 order to supply three Spectrum-IIs to the People's Republic of China, for installation at the Beijing (Peking) Institute of Technology, where they will be used in educational applications.

For further information on the Spectrum range contact D.D. Webster Electronics Pty Ltd, 17 Malvern St, Bayswater Vic. 3153. (03)729-8444.

ComputerLand on the Gold Coast

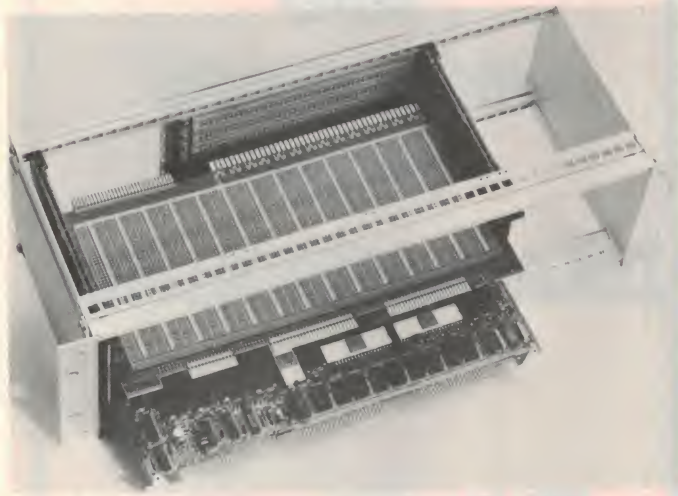
ComputerLand started in the USA only six years ago, and now has stores opening around the world at the rate of six every month. The ComputerLand store opening on the Gold Coast could well be the two hundredth, and will be owned and managed by 30-year-old Paul Rees, who brought the ComputerLand idea to Brisbane 2½ years ago.

Paul's Brisbane store is one of only twelve internationally which has topped sales of $200 000 in one month, and the new Gold Coast store is planned to be even bigger and better, with 2500 square feet for a giant service and repair depot where equipment can be assembled, tested and repaired. There will also be a well-stocked retail showroom where customers can browse.

Paul expects the new ComputerLand store to satisfy the requirements of the many thriving small businesses on the Gold Coast. "Over the last 2½ years we have become familiar with the huge range of microcomputer products, and we know which products are best for each particular application. We have also become very familiar with what the market in Queensland needs," he said.

Computerland started out by catering to the computer hobbyist, providing a wide range of small, inexpensive computers, programming manuals and lots of friendly advice and assistance. However, they now find that businessmen come into the stores with specific problems which they need to solve on a tight budget, without becoming involved in the technical details of computers. ComputerLand has therefore developed a wide range of hardware and software packaging expertise to cater for the requirements of most small businessmen. The idea of a computer supermarket for both hobbyist and businessman has become a reality.

The new Gold Coast ComputerLand store may be found at 126 Scarborough St, Southport Qld. 4215. (075)32-8300.



Vero boards for microprocessors

Vero have increased their range of Eurocard Microboards by introducing prototyping boards compatible with common microprocessor systems.

The systems they have chosen are the S100, Intel Multibus, Exorciser and Apple systems, because these are the commonest throughout the world.

In conjunction with the Exorciser and Multibus microboards, they have also introduced KM6-compatible dedicated motherboards. Used with their KM6 Horizontal Mounting Kit, the whole system can be mounted in a 3U x KM6 open card frame or case frame.

More information may be obtained from the distributors, Warburton Franki, 199 Parramatta Road, Auburn NSW 2144.(02) 648-1711.

Applied Technology now selling complete systems

NSW manufacturers Applied Technology, well known for their range of computer boards for hobbyists, have put together a range of complete personal computer systems.

All these systems are built around the DGZ80 single board S100/Z80 computer, which was originally incarnated as the ETI-680 in this magazine. Applied Technology's kits for this computer have found wide acceptance in industry, education and government departments.

The basic system is the Super Instructor 80, which includes the DGZ80, an MW640 VDU and a keyboard. The VDU is memory mapped, with a 16-line by 64-character format, and displays both upper and lower case. Because it is already S100, expansion requires no special interface. The system can be improved by adding the 'BASIC 80' pack, which includes Microworld BASIC in ROM and 16K of RAM.

Price of the Super Instructor 80 is $399, and the 'BASIC 80' costs a further $269. For more details contact Applied Technology Pty Ltd, 1a Pattison Avenue, Waitara NSW 2077. (02)487-2711.

New circuits stay cool at high speeds

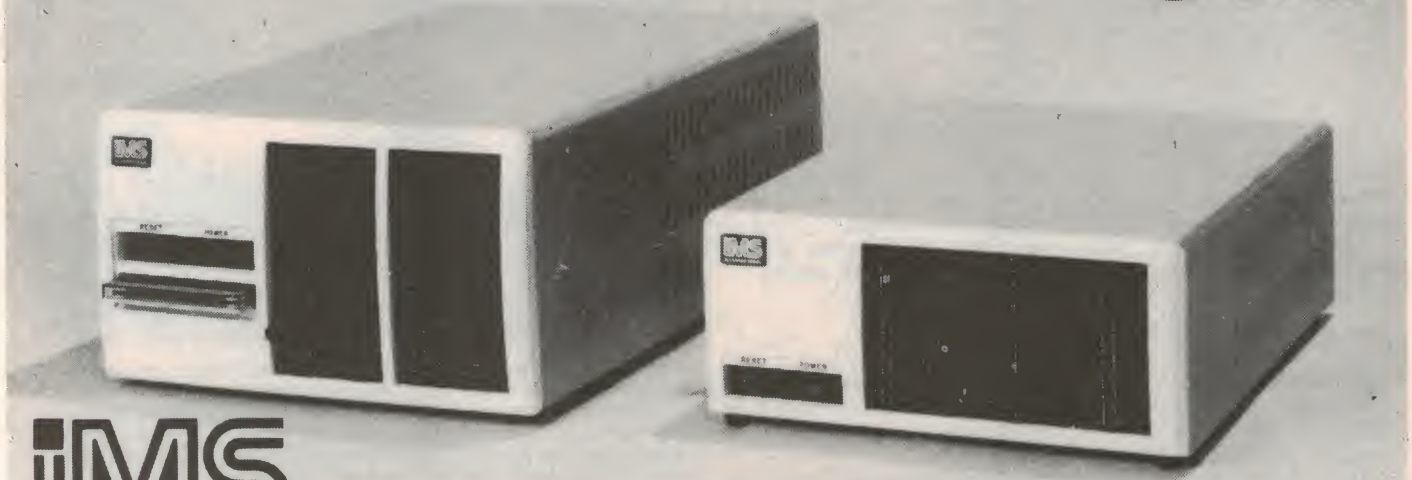
An experimental new circuit technology developed by two IBM engineers promises faster signal speeds with low power consumption.

The circuits, developed by Richard Konian and James Walsh, are reported to be faster than ECL (emitter-coupled logic) circuits, but can be packed just as densely as TTL (transistor-transistor logic). They also use much less power than ECL.

The speed and power consumption of the new Konian-Walsh circuitry depends on its density on the chip. If the designer of an IC wants high speed, a few thousand K-W circuits might be configured on a chip that uses around 2.5 milliwatts of power. If he wants high density, at least twice as many circuits might be connected on a chip with a power consumption of 0.5 to 0.7 milliwatts.

Konian-Walsh circuits are therefore the first to give designers the option of integrating both low and high-performance circuits on the same chip.

INTRODUCING...SX



IMS
INTERNATIONAL
COMPUTERS

THE 5000SX WITH:

CAPACITY: **5.5Mbyte Winchester plus two Quad Floppies.** If you know our Series 5000 table top computer line, you know that good things come in small packages. Now, with the introduction of the 5000SX, big things come in small packages. One integrated package can contain two double-sided quad-density floppies plus a 5.5 Megabyte Winchester hard disk drive (or other combination).

THE 8000SX WITH:

CAPACITY: **10, 20, or 40 Megabyte plus two double sided double density slimline drives and tape drive backup.** You've seen the familiar Series 8000 computer, now you can have the same rugged reliable system with an integrated 8" Winchester hard disk and tape backup drive, not to mention the slim (two drives in the space of one) double sided drives.

BOTH THE 8000SX AND 5000SX FEATURE:

SPEED: **Load 20K in less than 1 second.** Not only does our high performance Winchester subsystem include error detection with automatic error correction, its extreme speed is comparable to that of large mainframe hard disk systems. A 20K program loads in less than one second, about 10 to 12 times as fast as a floppy. We invite comparison with our competitors Winchester implementation, so you can see how a truly engineered solution speeds up your applications programs.

EXTRAS: **You'll be glad you have them.** The 5000SX comes standard with lots of extras, starting with a fully terminated 12- slot S-100 Motherboard, (on which there are 7 spare slots for your use!). Add to that, 64K Dynamic RAM modules with parity of course, and receptacles for your CRT and Printer that turn on with the main power switch. Plus a convenient up-front reset switch, built-in mains line filter and more.

EXPANSION: **Room for expansion is so important.** You can add multi-processor boards, memory, terminals, printers, up to three hard disks, in fact most any S-100 compatible sub-system.

SOFTWARE:

OPERATING SYSTEMS: **There's one to suit your needs exactly.** TurboDOS - the operating system that is single-task, single-task with spooling printers, multi-tasking and multi-processor networking, can handle up to 2 Gigabyte of on-line disk storage, gets up to 35% more data on a disk, is completely CP/M compatible, and allows random access files up to 67 Megabytes in size. It is many times faster than CP/M, and yet it does read-after-write and verify-after-seek. — Something that other operating systems cannot do without intolerable performance degradation.

CP/M, MP/M — of course.
MARC — the Unix style (CP/M compatible) operating system.
UCSD Pascal 1V — for both 5000 and 8000 systems
MVT-EFAMOS -- single processor multi-tasking system
Micro-COBOL — the professional COBOL system for micros

LANGUAGES AND APPLICATIONS PACKAGES: **Too numerous to list here, call us!**

QUALITY: **So good it's warranted for two years!** There isn't room on the page to even scratch the surface of the IMS International story. However, our two year warranty is a dead giveaway that we produce rugged, top quality, professional equipment. We do things right the first time, so they don't come back to us. The truth is, we have fewer returns within our two year warranty period than other manufacturers have within their 90-day warranty periods. For full details, and the location of your IMS International dealer, call us today, or write:

S.I. MICROCOMPUTER PRODUCTS PTY LTD

SYDNEY:	DUNCAN CRAVEN	(02) 231-4091	PERTH:	(09) 368 1800
MELBOURNE:	MARK DEWHIRST	(03) 26-5522	BRISBANE:	(07) 52 8455

Printout

TRS-80 Hotline

Users of TRS-80 who have problems can now get expert advice from Tandy via their newly established 'Computer Hotline'.

By dialling 008-22-6366 from anywhere in Australia (outside the Sydney Metropolitan area), they can get skilled help with all their hardware and software problems for the price of a local call. Callers in the Sydney area should ring 638-6633 and ask for the 'Computer Hotline'. Trained staff man the hotline 'phones from 9 am to 5 pm Eastern Standard Time, Monday to Friday.

For quickest service, hotline callers should be ready with information about their model number, memory size, number of disk drives and disk operating system, as well as any error messages connected with their problem.

Tandy would like callers to use the hotline only for calls about operating problems. Enquiries about prices, availability, and specifications of TRS-80 hardware and software should be made to local TRS-80 Computer Centres, Tandy stores or Tandy dealers.

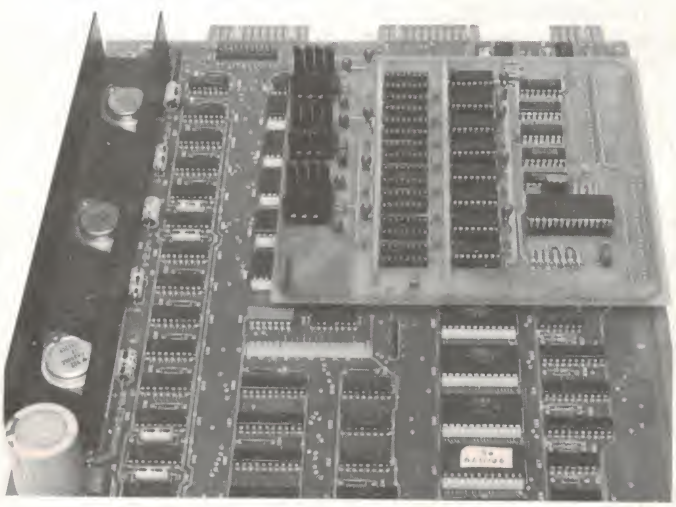
Tektronix now operates a fleet of vans in the Sydney and Melbourne metropolitan areas, to give faster service to users of its computer graphics equipment. Each van carries all the most commonly needed boards and other spare parts necessary for maintenance and repairs, and most repairs are carried out on the spot by trained technicians. Tektronix plans to extend the service later to its other service centres in Australia.

New USART available

Standard Microsystems Corporation has released the COM 8251A Universal Synchronous/Asynchronous Receiver/Transmitter (USART). The COM 8251A is a pin-for-pin replacement for the industry standard 8251A.

The COM 8251A USART provides the serial-to-parallel and parallel-to-serial data conversions for interfacing a parallel microprocessor buss to a serial bit stream. In addition, it provides the various 'handshakes' and controls required for both asynchronous and synchronous communication.

For additional information, please contact AJF Systems & Components, 310 Queen St, Melbourne Vic. 3000. (03)67-9306.



Memory upgrade for Commodore Computers

MicroPro Design now have available a memory upgrade module for Commodore computers which is said to allow the memory capacity of the 8K and 16K Commodore CBM microcomputers to be economically expanded to the full 32K bytes.

The module requires no tools for fitting or modifications to be made to the standard computer, and is plugged directly onto the memory expansion connectors inside the computer.

The unit was designed and manufactured in Australia and is supplied as a fully tested and assembled unit.

For further information contact A.J. Mowat, MicroPro Design Pty Ltd, Suite 205, 6 Clarke St, Crows Nest NSW 2065. (02)438-1220.

The Apple II Users' Guide
By Lon Poole
Osborne-McGraw-Hill, approx $17.

As its name suggests, this is not a beginner's book for Apple programming and operation. It is a guidebook for those who own an Apple II and would like the information contained in the manuals in one easy reference book. This book answers, in one reference, many of the most-asked questions of first-time Apple users.

The first chapter covers actual setting-up and describes the various pieces of hardware that typically accompany an Apple system.

The book goes on to explain some of the more commonly used keyboard commands of the Apple, including the loading and saving of cassette tape programs as well as the use of the more common disk commands. At this point it stresses correct handling of disk media and correct operation of the drives themselves. Setting-up is then discussed, although unfortunately no mention is made of the PAL colour card, which is necessary on Australian Apples.

Both Integer and Applesoft BASICs are covered, although this is not a complete instructional course in BASIC programming. Editing on the Apple is covered in this section, as is the operation of BASIC in immediate and deferred modes.

The chapter on the disk system describes each of the disk commands available in the Apple DOS. It does not attempt to be a complete 'teach-yourself' on the use of disk commands within a program and is basically little more than a short description of these commands. I was glad to see a chapter devoted to an area where the Apple has a great deal to offer the budding programmer.

Such topics as creating sound from machine language, the generation of shape tables and high-resolution graphics access from Integer BASIC are also covered, as is the saving of pictures and shape tables to both disk and tape.

What I considered to be the best feature of the whole book were the appendices, in which is contained a wealth of information on the various peeks, pokes and calls which are available. Also covered are the editing commands and error messages, while for the more advanced user, the Apple's memory map and disk format are also discussed.

This book strikes me as a reference manual containing much of the information which is spread over many Apple manuals, rather than a book for the teaching of new Apple users. The title pretty well sums up the contents as a guide to present Apple users, containing much useful information which otherwise would mean tedious searching through manuals to locate.

David Hanney
Computerland, Sydney

THE AUSTRALIAN SOURCE

PRESENTS . . .

THE ULTIMATE Christmas GIFT

A V.I.P. MEMBERSHIP WHICH ENTITLES YOU TO: 1.—UNLIMITED ACCESS IN OFF PEAK HOURS (6 p.m.-8 p.m.), 2—A MAXIMUM OF 4 HOURS USAGE DAILY DURING PEAK HOURS (8 a.m.-6 p.m.), 3—AN EXCLUSIVE V.I.P. HOT-LINE PHONE NUMBER FOR ASSISTANCE AND 4—SPECIAL EXTRA DISCOUNTS ON ALL PRODUCTS MARKETED BY THE AUSTRALIAN SOURCE.

ALL THIS (IN EFFECT A MAINFRAME COMPUTER CONNECTED TO YOUR MICRO-COMPUTER AT YOUR BECK AND CALL FOR A WHOLE YEAR) **FOR ONLY $1000.**

The AUSTRALIAN SOURCE is Australia's first microcomputer information utility, aimed at giving the average microcomputer user access to the computer data banks and also massive storage space previously only available to large Mainframe installations. The era of home computers has now officially begun in Australia, now that the AUSTRALIAN SOURCE is here; as now, any small businessman or student can have on his desk for an extremely small cost, a system that has the level of storage power and accesss to data banks for which only a few years ago, government departments and large private users were paying millions of dollars.

THE AUSTRALIAN SOURCE can be accessed through a number of 'approved' personal computers, and terminals, by use of an accoustic coupler or modem.

Users will receive a number of benefits which will include:

INFORMATION SERVICES

Members will have access to a number of information sources which will include the latest news, sports results, financial reports, and farm information.

NATIONWIDE ELECTRONIC MAIL

Members will be able, also, to communicate nationwide with other AUSTRALIAN SOURCE members through our electronic mail system.

SOFTWARE BANK

Users will have access to a myriad of computer programs that will include entertainment, educational aids, programming and diagnostic tools, and financial applications.

MAINFRAME POWER

Users will have the capability to make use of the Mainframe's huge storage capacity by using any of our large programs, or storing your large programs on our system.

EXTREMELY EASY TO USE

You do not have to be a computer programmer to make use of the AUSTRALIAN SOURCE. All of the instructions are in everyday English, so that even the younger members of your family will be able to operate the system.

LOW COST

While services like these used to cost tens of thousands of dollars to the government departments and large corporations who used them, they ar are now available to you for less than the cost of a packet of cigarettes a day for the 'average' user.

You can join the AUSTRALIAN SOURCE by paying a one-time joining fee (normally $100) and a small hourly user charge (normally $10 an hour 8 a.m.-6 p.m. and $4.50 an hour 6 p.m.-8 a.m.).

THE AUSTRALIAN SOURCE RECOMMENDS 3M DISKETTES

THE AUSTRALIAN SOURCE IS PROBABLY THE BEST VALUE THERE IS IN THE MICRO-MARKET TODAY.

INFORMATION REQUEST

Please send me your free information on your special offer as a Christmas Gift or for myself.

Name _____

Address _____

City _____

State _____

Postcode _____

Phone _____

I am not interested in the special offer, but send me information on joining on a regular membership basis.

THE AUSTRALIAN SOURCE PTY LTD
364 LATROBE ST., MELBOURNE VIC 3000
(03) 329 7998

MICROCOMPUTER OWNERS & BUYERS

IMPORTANT NOTICE

GREAT NEWS FROM COMPUTER COUNTRY

It is not necessary to trade off getting the professional pre-sales advice and after-sales hardware and software back-up and service that Computer Country that hs long been famous for in order to get low prices for your computer purchases. Computer Country because of its large sales volume and keen sourcing ability is now able to give extremely low prices and probably be able to meet or better any prices you will be quoted elsewhere.

INTRODUCING THE NEC PC-8000 PROFESSIONAL COMPUTER

It combines the most wanted features of existing micros with new features you have always been looking for.

These features include 4MHz Z-80 CPU, 80x25 display with graphics and 8 colors, 32K Ram (expandable to 64K), 24K ROM, parallel/serial/cassette interface, upper/lower case, numeric keypad, 10 special function keys and real time clock — all built in.

The NEC Professional Computer gives you much more for your money than almost any other micro on the market.

APPLE OWNERS!

NEW DIGICARD PAL CARD

Great color plus displays text in either green or white. Only — **$189 Tax Free.**

CPS MULTIFUNCTION CARD

3 Cards in one.
Calendar/clock, serial and parallel interface only — **$325 Tax Free.**

CCS CALENDAR/CLOCK MODULE

Puts Date and Time at your fingertips.
Only — **$189 Tax Free.**

ASK FOR OUR GREAT SPECIAL PRICES ON NORTHSTAR COMPUTERS.

FRANCHISE OPPORTUNITIES

JOIN "COMPUTER COUNTRY"

CASH-IN ON EXPLOSIVE GROWTH

Now you have a chance to get your share of the explosive growth of the microcomputer industry. "COMPUTER COUNTRY" is a retail microcomputer showroom marketing concept which offers a wide range of microcomputer products and accessories designed to satisfy the requirements for small business management, personal use as well as educational and scientific applications.

A COMPUTER COUNTRY area franchise is a unique and rewarding venture in a highly dynamic and rapidly expanding field. It is more than a business, it represents an innovative approach to conventional problem solving.

Of the people you know today, probably very few can operate a computer right now. Yet in the not too distant future, computer operation will become a basic element in day-to-day functions for anyone who works, plays or studies. As a COMPUTER COUNTRY area franchisee, you can participate in the huge growth that is only around the corner for the microcomputer industry. You can create for yourself, more than just a successful business, but a very valuable asset that will grow as you, the microcomputer industry and Australia grows in the 1980s.

CALL THE MANAGING DIRECTOR *NOW* BEFORE YOUR STATE IS TAKEN.

COMPUTER COUNTRY

338 Queen Street,
Melbourne, Vic., 3000
329 7533

Printout

Vector's new system has 8-inch Winchesters

32 megabytes of mass storage are available on the new Vector 3032 system, thanks to the inclusion of an eight-inch Winchester hard disk drive.

Vector say they opted for Winchesters rather than cartridge-type hard disks, because they are cheaper, more reliable, faster and need no preventive maintenance. The 32 megabytes of disk storage allows software to make full use of the maximum size files (8 megabytes) allowed by the CP/M 2 operating system.

Like other members of the Vector 3 family, the 3035 uses a Z80B microprocessor and a 4K ROM. However, the microprocessor is clocked at 6 MHz, a 50% increase in speed, which should lead to a significant increase in system performance.

As well as the Winchester, the 3032 also includes a 680K mini-floppy disk drive, which can be used to back up critical data files. Both the hard disks and the floppies are controlled by a version of the Vector's DualMode disk controller and the accuracy of the data stored on them is protected by Vector's Automatic Error Detection and Correction system. Floppy and hard disk drives are both contained in a single unit that can sit on top of or underneath a desk.

More details from the distributors, Dicker Data Projects Pty Ltd, 24 Woodfield Blvd, Caringbah NSW 2229. (02)524-5639.

Sanyo screen is easy on the eyes

Sanyo's DM 8112CX data display monitor incorporates several features aimed at improving the eye comfort of its operators.

Its non-reflective P31 green screen has a resolution of 850 lines at the centre, and its almost flat surface reduces distortion at the edges. This is particularly important in word processing applications with 80 columns of characters on the screen.

Designed to meet the needs of OEM computer and data processing companies, the monitor's conservative styling should enable it to be matched with most of the related hardware currently being produced.

For further information contact Sanyo Office Machines Pty Ltd, 127 Walker St, North Sydney NSW 2060. (02)929-4644.

Real time multitasking software

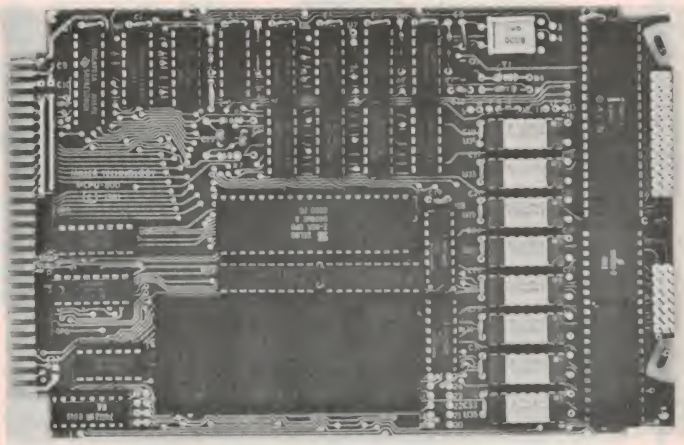
A new software package from Motorola includes all the basic task control algorithms necessary for complex real time multitasking functions.

Real time systems respond to external events as they occur. Unlike batch systems, where each operation is completed before the next is begun, real time systems can delay the completion of one operation so that another operation can be started, continued or completed. Keeping two or more operations in progress at one time is called concurrent processing or multitasking. Although a single MPU can only be working on one operation at a time, multitasking gives the illusion of several operations executing simultaneously.

The new Motorola software is called RMS68K. It includes a task controller, an inter-task communication facility, an initialisation facility and an optional memory management facility. It can be used in customer-designed hardware incorporating the Motorola MC68000 microprocessor, or in systems built around the Motorola VERSAmodule monoboard microcomputer.

RMS68K is also compatible with the EXORmacs development system and the VERSAdos operating system. This means that programs designed to execute under the control of RMS68K will also execute under the control of VERSAdos on the EXORmacs system.

For information contact David Ednie of Rank Electronics on (03)541-8444.



Single-board micro has up to 64K RAM and 32K ROM

The MCPU-800 single board microcomputer from Memory Electronics is claimed to have more computing power, memory and I/O capability than any comparable product.

The STD compatible board, which is configured around a Z-80A clocked at 4 MHz, measures only 175 mm x 115 mm x 12 mm. Four 24-pin sockets accept 2K, 4K or 8K ROM and EPROM chips, and on-board jumpers allow different density chips to be mixed on the same board. RAMs may be single-supply 16K, 32K or 64K dynamics, or triple-supply 16K. A memory map port allows use of both RAM and ROM in the same address space.

Many applications can be served by the MCPU-800 card alone, eliminating the need for a card cage and motherboard, but addition of an STD Disk Controller board enables it to be used in a full Z80 computer system with up to four disk drives, with many slots still available for special purpose cards like analogue or digital I/O.

For more details, contact Memory Electronics, 70 Patterson Road, Moorabbin Vic. 3189. (03) 557-7992 or 557-5394

Queensland Commodore User's Group

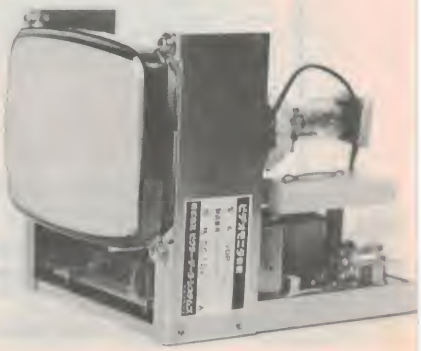
The Commodore Users' Group of Queensland meets on the first Tuesday of every month at Construction House, 130 Petrie Terrace, Brisbane at 7.00 pm. Business begins at 7.30 pm.

For more information call Bill Brown during business hours on (07)397-0888, or Mrs. Dillon after hours on (07)349-6612.

Victor mini monitor

The latest CRT monitor from Victor is a compact high-resolution model designed for use in industrial and commercial environments.

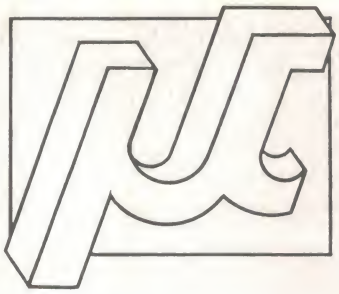
The VDP-582S offers 500-line resolution on a P31 green phosphor screen measuring 95 mm x 70 mm. The circuitry includes a spot killer to ensure long life for the phosphor coating. It requires only a 12 volt dc supply, which makes it suitable for mobile operations.



Rear-mounted controls are provided for adjustment of brightness, vertical hold, horizontal hold, vertical height and vertical linearity.

For more information, contact Alfatron Pty Ltd, 1761 Ferntree Gully Road, Ferntree Gully Vic. 3156. (03)758-9551.

microtrix S100 MICROCOMPUTING



WE TAKE S100 SERIOUSLY

Introducing a high quality, cost-effective, locally produced S100 microcomputer system. And we are proud of our achievement!

QUALITY IS BUILT IN

For a system to be of truly high quality, each element must meet exacting standards. We began our system by designing our own 12-slot motherboard, power supply, and cabinet. We then chose a series of S100 boards whose reliability and performance was well-known; added a floppy disc subsystem; and found a VDU with just the right features we wanted. The result was a complete microcomputer system with impressive specifications.

THE BASIS

As the motherboard is the link between all system components, it deserves special attention. We incorporated state-of-the-art design features like true active termination, and microstrip interconnecting lines. Crosstalk between adjacent lines and signal reflections have been largely eliminated for reliable data transfer, even at the high operating speeds of the new microprocessors.

The power supply has been designed for dependable operation and offers substantial scope for expansion. A full 20A at 8 volts and 4A for the other two supplies is sufficient for an entire complement of cards. You may not need all the capabilities now, but its nice to know they're there when you do.

A lot of effort went into producing an aesthetically pleasing case. Constructed of aluminium and only seven inches high, the cabinet is finished in textured beige and brown with a silk-screened front panel. Its appearance makes it equally suitable for the laboratory or office environment. A cooling fan is supplied as standard.

BUT WHAT'S INSIDE?

The heart of the system is the SBC200 by S.D. Systems, a Z-80 based CPU running at 4 MHz. An RS232 I/O port allows connection to a terminal, and a parallel port to a printer. Automatic baud rate selection is provided by virtue of a counter/timer circuit, three channels of which can be used for other functions. Up to 16K of EPROM can be stored on the CPU card, making for a compact system.

The concept of efficient use of components is further demonstrated by the dynamic memory card. One ExpandoRAM 2 can hold up to 64K bytes of RAM, expandable to 256K bytes using the latest chips. The bank select feature allows the use of up to eight boards simultaneously for multiuser applications.

Either single or double density recording is possible with the Versafloppy 2 disc controller. Both eight and five inch drives may be used, in combination if required. Phase locked loop data recovery circuitry ensures data integrity and high reliability.

In combination with the Versafloppy 2, our dual eight inch floppy disc subsystem can store up to two megabytes of information. Packaged in a cabinet matching our card cage, it comes complete with double sided drives, power supply, cooling fan and cable.

SO, WHAT DO YOU GET?

The combination of our cabinet, floppy disc system, visual display unit, and three S100 cards produces a complete and very powerful microcomputer system. Its areas of application are numerous, including word processing, small to medium businesses, accounting work, education, and research. And you will be pleasantly surprised at its low cost. But the good news is that any element can be obtained separately. You can start in a small way and expand when the need arises, knowing that all parts are designed to work together perfectly. Further extension will also be possible: multi-user systems are available now, and hard disc systems are being developed.

Price for a complete system with 64K memory, 2.5 Megabytes of disc storage, CP/M 2.2 disc operating system, and a Hazeltine Esprit green screen terminal, is just $5195.

SYSTEM PRODUCTS

S100 CARD CAGE
Attractive sprayed aluminium, complete with 12 slot motherboard, cooling fan, and 20A power supply. Fully assembled & tested. **$350**

FLOPPY DISC SUBSYSTEM
In a matching cabinet to our card cage, complete with twin double-headed Remex or YE Data drives. Fully assembled & tested with cable. **$1850.**

SBC 200 SINGLE BOARD COMPUTER
Z-80 based 4 MHz microcomputer with 1K RAM and sockets for 8K/16K PROM, synchronous and asynchronous serial I/O port with software programmable baud rate generator, RS232 interface, parallel ports, four channel counter/timer, power-on jump, and vectored interrupt operation. Kit with monitor in 2716 PROM **$350**

EXPANDORAM 2 DYAMIC RAM
A single dynamic RAM card that will hold 64K. Expandable to 256K with the latest chips. Page mode operation allows the use of up to eight boards for multiuser applications. Supplied with 200 nS 2116's for 4 MHz operation. Ideal for use with the SBC 200 and Versafloppy 2. Kit 16K **$360**, 32K **$440**, 48K **$520**, 64K **$600**

VERSAFLOPPY 2 DISC CONTROLLER
State-of-the-art controller operates with all combinations of drive types in single or double density modes, and has PLL data recovery circuit. Operates with SDOS or CP/M 2.2. Kit **$350**

PROM 100 PROM PROGRAMMER
Capable of programming all popular EPROMs such as 2708, 2758, 2716 and 2732. Zero insertion force socket is standard. Kit **$199**

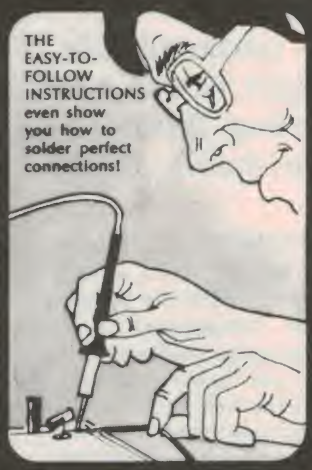
VDB 8024 VIDEO DISPLAY BOARD
On-board Z-80 and CRT 5037 controller I/O mapped, 80 x 24 lines plus programmable characters. Kit **$370.**

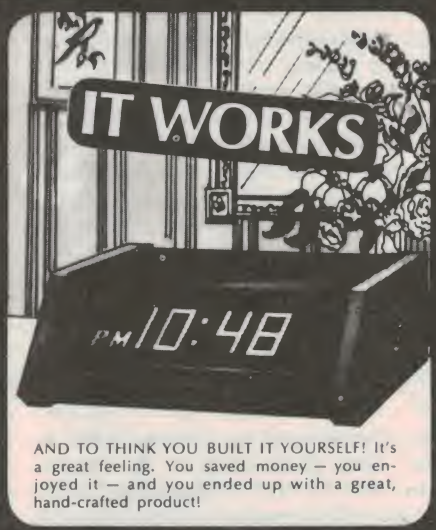
Z-80 STARTER KIT
This is a unique design, especially suitable for education, control applications, experimentation, and for those who want a complete system for the lowest possible outlay. It is a complete microcomputer based on the Z-80 and contains a keyboard and seven segment display. Ideal for evaluting the Z-80 or learning about microprocessors, it provides 1K of memory on board (expandable to 2K); contains a PROM programmer that is suitable for the 2758 and 2716 EPROM's; includes a cassette interface for the storage and loading of programs; and comes with a powerful monitor (ZBUG) that provides a large number of functions. A wire wrap area allows the addition of custom circuitry, and the provision for two S100 sockets means expansion is almost limitless. Two bidirectional I/O ports and a counter/timer circuit completes the impressive list of features. Kit **$340.**

A range of software is available to suit the above system, as are other peripherals such as dot matrix and daisy wheel printers. Please send for a complete catalogue.

MICROTRIX Showroom/Workshop: 75 Grand Boulevard, Montmorency.
Office/postal: PO Box 158, Hurstbridge, Vic., 3099 Ph. (03) 718 2581

What's so hard about building a Heathkit product?





You can start right now...fill in the coupon and mail it today!

Every Heathkit product in our '81 catalog is designed to be built by people with little or no prior knowledge or kit-building experience. For more than a quarter of a century, people from every walk of life have been building them—successfully—and so can you.

Heathkit products offer outstanding performance with kit-form savings and provide the satisfaction that comes from creating something of value with your own hands.

Each kit includes a comprehensive, easy-to-understand assembly manual that reduces even the most complex operation to a simple step-by-step procedure. Every step is fully explained and illustrated. The possibility of error is practically eliminated because you check your work as you go.

Find out how you can enjoy the savings, value and personal satisfaction of building your own Heathkit products, by sending for the 1981 Heathkit catalog today!

FREE

Send to
Warburton Franki Heathkit Centre
220 Park Street, South Melbourne, Vic. 3205. Phone: 699 4999

Name .....

Address .....

State ..... **Postcode** .....

WF769/80

Newton's cool

This program can be looked upon as a macabre twist of the game of Life. Morbid-minded physicists will take delight in this unusual application of Newton's Law of Cooling. Botanists, biologists and other lay people are let in on the secret first so that they too can play the game.

J.D. Lee and T.D. Lee

NEWTON'S Law of Cooling states that the rate at which a body cools in a draught is directly proportional to the excess temperature — that is, the temperature difference between the body and its surroundings. Whilst this should be well known by physicists, who regard any object as a body, it is less frequently known by others.

To illustrate this law an example is chosen which is likely to be remembered by a wide variety of morbid users. The example deals with bodies — dead bodies! The way in which the time of death of a body may be established from temperature readings will be described. This will be immensely useful to potential pathologists and aspiring assassins, and a computer program is provided for the benefit of non-physicists.

Background

When alive, a human body is closely regulated to maintain a temperature of 98.4°F (approximately 37°C) except during illness such as a fever. When a person dies, their body is no longer maintained at this temperature and consequently it gradually cools towards room temperature. For a physicist's type of body, for example a bar of metal, the rate at which the heat is connected along the bar is given by:

$$-\frac{dQ}{dt} = K A \frac{\Delta\theta}{\Delta x} \qquad (1)$$

where — dQ/dt is the rate of heat loss with time,
K is the thermal conductivity of the metal,
A is the (cross sectional) area through which heat travels,
$\Delta\theta$ is the temperature difference between the two ends,
Δx is the distance between the two ends.

For a human body, the heat is conducted from the centre of the body, through the skin and clothes to the air. In a strong draught the warmer air is immediately blown away. The constant K in equation (1) represents the thermal conductivity of skin and clothes combined, A is the surface area of the body and Δx is the thickness of skin and clothes. Not only are these three terms unknown, they also vary depending on the physique and state of dress of the particular body. Nevertheless, they are constant for any one body. Thus:

$$-\frac{dQ}{dt} \text{ is proportional to } \Delta\theta \qquad (2)$$

Moreover the heat content, Q, of a body is its heat capacity multiplied by its absolute temperature θ. Thus: Q is proportional to θ, hence

$$-\frac{dQ}{dt} \text{ is proportional to } -\frac{d\theta}{dt} \qquad (3)$$

Combining equations (2) and (3) shows that the rate of cooling, $-d\theta/dt$, of the body is proportional to the excess temperature, $\Delta\theta$. Newton arrived at the same conclusion about three hundred years ago!

Programming the macabre!

Mathematically it can be shown that the body temperature falls exponentially towards the air temperature. If a body temperature reading is taken at an unknown time after death, it is not possible to calculate when the body was at 98.4°F since the proportionality constant is not known. However, if two temperature readings are taken with a known time interval between them, then the time of death may be calculated.

$$\text{Time of death} = \frac{\ln\left[\dfrac{\text{first body temperature} - \text{air temperature}}{\text{body temperature} - \text{air temperature}}\right]}{\ln\left[\dfrac{\text{second body temperature} - \text{air temperature}}{\text{body temperature} - \text{air temperature}}\right]} \times \text{time between readings}$$

The time of death thus calculated is given as the time before the first temperature reading was taken. Unfortunately Newton's Law of Cooling only applies in a strong constant draught, which would be the case in an exposed windy location, or in an air conditioned building. In still air, the air warms up and natural convection occurs. The rate of cooling $-d\theta/dt$ is given by

$$-\frac{d\theta}{dt} \text{ is proportion to } \Delta\theta^{5.4}$$

rather than

$$-\frac{d\theta}{dt} \text{ is proportional to } \Delta\theta$$

as given by Newton's Law of Cooling. The time of death may be calculated.

$$\text{Time of death} = \frac{\ln\left[\dfrac{\text{(first body temperature} - \text{air temperature)}}{-\text{(body temperature} - \text{air temperature)}}\right]}{\ln\left[\dfrac{\text{(second body temperature} - \text{air temperature)}}{-\text{(first body temperature} - \text{air temperature)}}\right]} \times \text{time between readings}$$

The Five-Fourths Law of Cooling was determined empirically by Dulong and Petit, and justified theoretically by Lorentz in 1881. Users who are surprised at their results are referred to those mentioned above or to Newton himself!

A BASIC program is provided, written in a most elementary sub-set of the language, which should facilitate its implementation on a wide variety of computers. A sample run is also provided.

Description of the program

The program first asks if the user requires full instructions. An answer of YES or NO is expected and all other responses are rejected. Depending on the answer explicit or shortened messages are printed during the first run. Regardless of the answer, short messages are always given on the second and subsequent runs.

The user is invited to choose whether to use the Celsius or Fahrenheit temperature scales. The reply is checked and only C or F are allowed.

In turn the air temperature, the first body temperature and the second body temperature are requested. Checks are performed to ensure that the numbers entered are reasonable. Warning messages are printed if the values are out of range and the user has to re-type an acceptable value. Finally the user is asked for the time of the interval between the temperature readings. This too is checked, and must be positive and less than five hours.

The time of death is calculated using Newton's Law of Cooling (in a draught), and the Five-Fourths Law.

An explanation of the methods is pro-

vided on request and finally the user is asked if he would like another run.

List of variables

The strings Q$ and I$ are used for the replies to questions and whether full instructions are required respectively. These are DIMensioned in line 10 so that I$ may contain up to three characters and Q$ up to ten characters. For a number of versions of BASIC strings are handled in a different way and DIM I$ (3) reserves space for four strings I$(0), I$(1), I$(2) and I$(3). For such implementations of BASIC line 10 should be omitted.

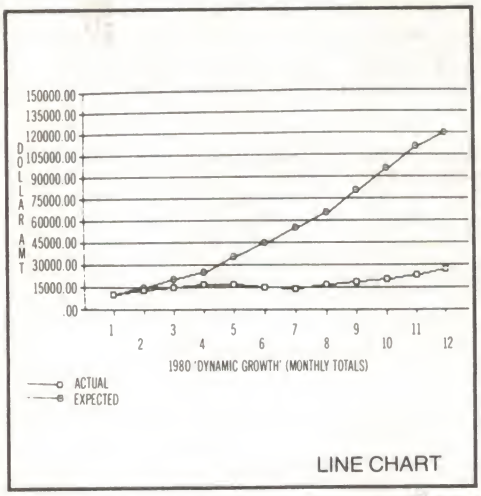
A Air temperature surroundings
B Body temperature (when alive)
D Death time in minutes before first reading
F First temperature reading made on corpse
S Second temperature reading made on corpse
T Time in minutes between the two readings

Program Listing

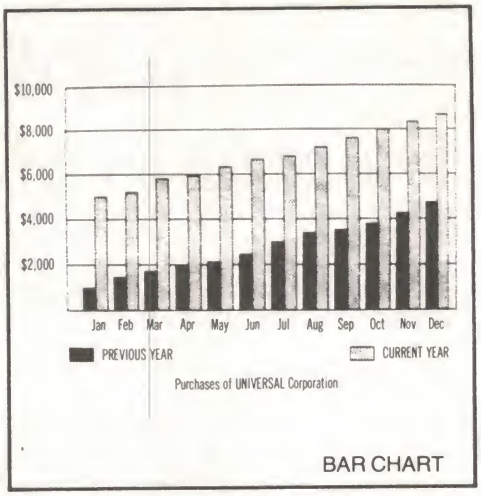
```
10 DIM I$(3), Q$(10)
20 PRINT TAB(30); "Time of Death"
30 PRINT TAB(30); "============="
40 PRINT
50 PRINT "Would you like FULL instructions"
60 GOSUB 940
70 LET I$ = Q$
80 IF I$ = "NO" THEN 160
90 PRINT
100 PRINT "This program calculates how long a person has been dead"
110 PRINT "from two body temperature readings, the time between the"
120 PRINT "readings and the surrounding air temperature.  Newton's"
130 PRINT "Law of Cooling is assumed if the body is in a draught"
140 PRINT "otherwise the Five Fourths Law of Natural Convection is used"
150 PRINT
160 PRINT "Would you like to work in degrees Celcius or Fahrenheit"
170 IF I$ = "NO" THEN 190
180 PRINT "Type C or F and press RETURN"
190 INPUT Q$
200 REM *** SET NORMAL BODY TEMPERATURE B
210 LET B = 98.6
220 IF Q$ = "F" THEN 270
230 LET B = 37
240 IF Q$ = "C" THEN 270
250 PRINT "Reply '"; Q$; "' not understood. Re-";
260 GOTO 180
270 PRINT "Type the air temperature"
280 INPUT A
290 IF (A + 40) * (A - B) < 0 THEN 330
300 PRINT "The air temperature must be between -40 degrees"
310 PRINT "and"; B; " degrees. Re-";
320 GOTO 270
330 PRINT "Type the first body temperature"
340 INPUT F
350 IF (F - B) * (F - A) < 0 THEN 390
360 PRINT "The first body temperature must be between"; B; " and"; A;
370 PRINT "degrees.  Re-";
380 GOTO 330
390 PRINT "Type the second body temperature"
400 INPUT S
410 IF (S - F) * (S - A) < 0 THEN 450
420 PRINT "The second body temperature must be between"; F; " and"; A;
430 PRINT "degrees.  Re-";
440 GOTO 390
450 LET S = S - A
460 LET F = F - A
470 LET B = B - A
480 PRINT "Type the time in minutes between temperature readings"
490 IF I$ =  "NO" THEN 510
500 PRINT "Then press RETURN"
510 INPUT T
520 IF T * (T - 300) < 0 THEN 570
530 PRINT "The time must be between 0 and 300 minutes (five hours)"
540 PRINT "Re-";
550 GOTO 480
560 REM *** CALCULATE TIME OF DEATH USING NEWTON'S LAW OF COOLING
570 LET D = INT(LOG(F / B) * T / LOG(S / F) + 0.5)
580 PRINT "Assuming that the body was in a strong constant wind,"
590 PRINT "the person died";
600 IF D < 60 THEN 620
610 PRINT INT(D / 60); " hours and";
620 PRINT D - 60 * INT(D / 60); " minutes before the first reading."
630 PRINT
640 REM CALCULATE TIME OF DEATH USING FIVE FOURTHS LAW
650 LET D = INT((B^(-.25) - F^(-.25)) * T / (F^(-.25) - S^(-.25)) + 0.5)
660 PRINT "If the body was in still air then a better estimate is"
670 IF D < 60 THEN 690
680 PRINT INT(D / 60); " hours and";
690 PRINT D - 60 * INT(D / 60); " minutes before the first reading."
700 PRINT
710 PRINT "Would you like an explanation of the methods"
720 GOSUB 930
730 IF Q$ = "NO" THEN 850
740 PRINT
750 PRINT "The first method uses Newton's Law of Cooling which assumes"
760 PRINT "that the rate of cooling of a body is proportional to the"
770 PRINT "temperature difference between the body and the atmosphere."
780 PRINT "Newton's Law applies if the body is in a strong constant"
790 PRINT "draught eg. an air conditioned room.  Such cooling is called"
800 PRINT "FORCED convection.  If the atmosphere is still Newton's Law"
810 PRINT "does not apply and the heat loss is proportional to the"
820 PRINT "excess temperature to the power 1.25.  This is called the"
830 PRINT "Five Fourths Law for NATURAL convection and gives rise to"
840 PRINT "the second result."
850 PRINT
860 PRINT "Would you like another run"
870 GOSUB 930
880 LET I$ = "NO"
890 IF Q$ = "YES" THEN 150
900 PRINT "You are finished - Rigor Mortis has set in"
910 STOP
920 REM *** SUBROUTINE TO SORT OUT YES / NO ANSWERS
930 IF I$ = "NO" THEN 950
940 PRINT "Type YES or NO and press RETURN"
950 INPUT Q$
960 IF Q$ = "YES" THEN 1000
970 IF Q$ = "NO" THEN 1000
980 PRINT "Reply '"; Q$; "' not understood. Re-";
990 GOTO 940
1000 RETURN
1010 END
```

Sample run

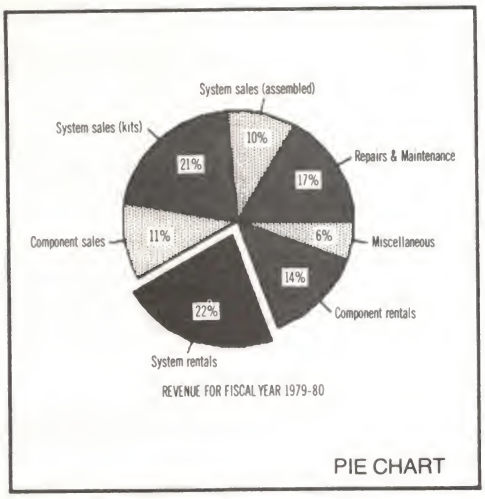
```
                          Time of Death
                          =============
Would you like FULL instructions
Type YES or NO and press RETURN
? YES

This program calculates how long a person has been dead
from two body temperature readings, the time between the
readings and the surrounding air temperature.  Newton's
Law of Cooling is assumed if the body is in a draught
otherwise the Five Fourths Law of Natural Convection is used

Would you like to work in degrees Celcius or Fahrenheit
Type C or F and press RETURN
? C
Type the air temperature
? 6
Type the first body temperature
? 25
Type the second body temperature
? 14
Type the time in minutes between temperature readings
Then press RETURN
? 45
Assuming that the body was in a strong constant wind,
the person died 25  minutes before the first reading.

If the body was in still air then a better estimate is
21  minutes before the first reading.

Would you like an explanation of the methods
Type YES or NO and press RETURN
? YES

The first method uses Newton's Law of Cooling which assumes
that the rate of cooling of a body is proportional to the
temperature difference between the body and the atmosphere.
Newton's Law applies if the body is in a strong constant
draught eg. an air conditioned room.  Such cooling is called
FORCED convection.  If the atmosphere is still Newton's Law
does not apply and the heat loss is proportional to the
excess temperature to the power 1.25.  This is called the
Five Fourths Law for NATURAL convection and gives rise to
the second result.

Would you like another run
Type YES or NO and press RETURN
? NO
You are finished - Rigor Mortis has set in

OK,
```



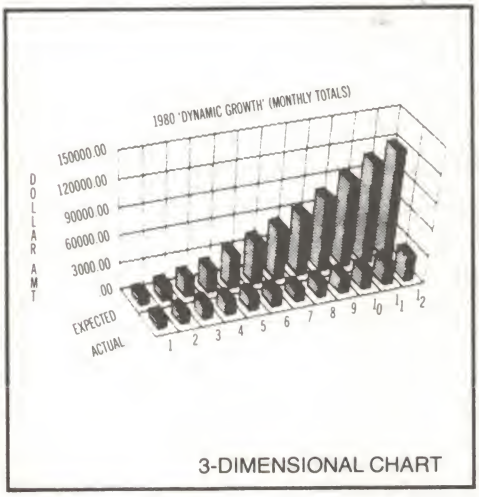
LINE CHART



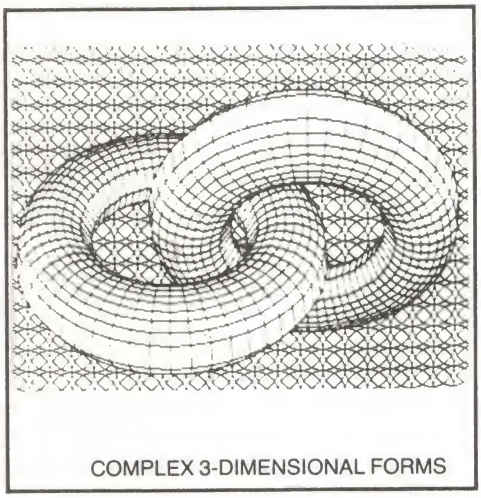
BAR CHART



PIE CHART



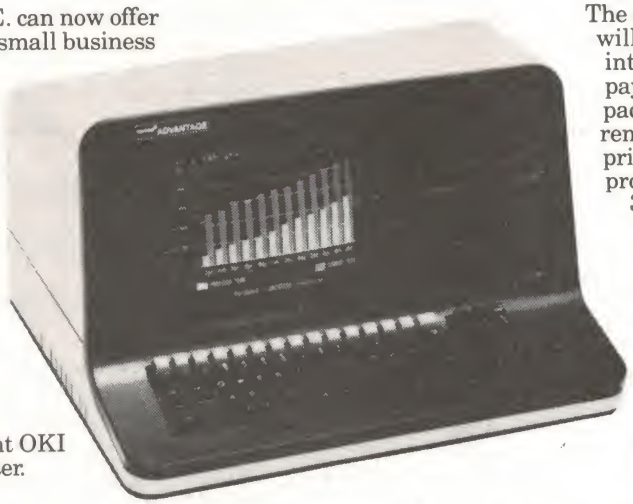
3-DIMENSIONAL CHART



COMPLEX 3-DIMENSIONAL FORMS

A business with all this at its fingertips must have an ®Advantage.

With the North Star Advantage, A.D.E. can now offer to the computer industry a significant small business computer breakthrough. For the first time there is available a high performance, fully integrated desktop computer capable of producing bar charts, pie charts, plotted graphics and three-dimensional visuals.
The Advantage's features include two integrated double-sides, double-density floppy disk drives, an 87 key Selectric® style keyboard which includes 15 programmable function keys, a 12-inch green graphics display, business graphics software and self-diagnostic capabilities. The A.D.E Advantage package is completed with the excellent OKI Microline 82A Serial Dot Matrix Printer.



The small business computer user will be able to integrate graphics into everyday business without paying a premium. The Advantage package is available for a remarkable $5,595. At that sort of price, and with the ability to produce everything from a 3-dimensional visual to a pie chart, the Advantage will give businessmen a chance to grab a bigger slice of the profit pie. Talk to your A.D.E. Representative now.

NorthStar

ANDERSON DIGITAL EQUIPMENT PTY LTD

P.O. Box 322, MT. WAVERLEY, VIC. AUST. 3149 Phone: (03) 543 2077. P.O. Box 341, Pennant Hills, N.S.W. AUST. 2120. Phone: (02) 848 8533. **Adelaide:** 46 4062. **Perth:** 387 6055. **Hobart:** 34 4522. **Brisbane:** 350 2611. **Darwin:** 81 2712. **Canberra:** 58 1811. **Newcastle:** 69 1625. **Albury/Wodonga:** (060) 26 7209. **New Zealand. Wellington:** 69 3008. **Auckland:** 54 4224. **Christchurch:** 4 3001. **New Guinea. Lae:** 42 3924.

ADE

*Price includes duty, sales tax applicable.

®Registered Trade Mark

DHA/ADE5981/NST

A single-board computer using the 2650 on an S100 card

The S100 buss has become one of the most successful buss standards for both hobbyist and professional applications. Most past ETI computer projects have supported this buss. This project continues the line of succession and uses the popular 2650 microprocessor in a single-board computer design with many features not found elsewhere. It is compatible with our previous S100 projects (e.g: the 640 VDU and 681 PCG) and follow-up projects and articles are to come.

Ron Koenig

THE INTRODUCTION of the microprocessor to the electronics scene has brought with it many great possibilities and many new challenges for both the hobbyist and professional system builder. While the microprocessor is extremely flexible and is capable of excelling in most applications over 'discrete' circuit assemblies, it is unable to operate by itself. The microprocessor is only a system component and must be supported by a variety of additional components to be capable of performing any given task.

The basic microcomputer system is composed of three main units, or modules. These are: the Central Processing Unit (CPU), the Memory Unit and the Input/Output (I/O) Port Units. The CPU with its associated control circuitry performs all the processing and system control operations. The Memory Unit usually consists of several blocks of memory, each with its own address decoding circuitry. The memory blocks can consist of either non-volatile Read Only Memory (ROM) in which is stored permanent programs (or data), or Random Access Memory (RAM) in which is stored variable data that is subject to change during program execution. The Input/Output Units and the associated control circuitry provide the primary means by which the 'external world' can communicate with the CPU. All these units may be located simultaneously on one board or on separate boards, and are normally interconnected by a standardised system buss. (A 'buss' is a system or group of interconnections common to an assembly of different devices).

In many applications the microcomputer system is custom designed for the application required, but this is generally very expensive and quite inflexible to the needs of future expansion. Instead of designing individual cards which are dedicated to one application, it is often more cost effective to design small general purpose cards which can be used as building blocks for larger systems. This individual tailoring allows the finished system to suit any given application and, by its very nature of construction, is more flexible to the needs of future expansion.

Fortunately, the microprocessor lends itself naturally to the modular system approach. The concept of the buss-structured system can therefore be utilised to its maximum and provide the system designer with a means by which he can buy and develop small general purpose cards and interconnect them via the microprocessor buss.

The microprocessor buss forms the backbone to the microcomputer system. ▶

GENERAL SPECIFICATIONS — ETI 685

- Accommodates 2650A (1 MHz) or high speed 2650A-1 (2 MHz) CPUs.
- On-board 4 MHz crystal oscillator supplying the CPU and buss clocks.
- 4K of on-board RAM memory switchable to any 4K address boundary.
- 4K of on-board EPROM memory configured as:
  - -1K, 2K or 4K of EPROM memory commencing at '0000' hex.
  - -Supports multirail and single rail 2708 and 2716 EPROMs.
  - -Selected on-board EPROM has priority over RAM Memory.
  - -ROM memory can be enabled and disabled by software.
- The PHANTOM signal is generated when on-board RAM or EPROM is selected to disable any 'secondary' memory on the buss at the same address.
- One SERIAL PORT supported as EIA RS-232C and current loop.
- One latched 8-bit PARALLEL-IN 'keyboard' PORT.
- One Programmable Peripheral Interface (PPI) providing THREE PROGRAMMABLE PORTS. This PPI can provide combinations of static or strobed I/0, strobed bi-directional or serial I/0 and 16-bit timer operations.
- One Programmable Interrupt Controller (PIC) providing eight levels of programmable vectored interrupts.
- Non-vectored interrupts using pINT and sINTA.
- Full S100 processor and status signal generation:-
  - -pWR, pDBIN, sMEMR, sMWRT, sWO, sINP and sOUT for memory and I/0 data interchange.
  - -pSTVAL, pSYNC, ∅ (1 MHz) and CLOCK (2 MHz) for buss timing.
  - -pOC for system initialisation.
- Fully buffered status, address and data lines.
- Direct Memory Address (DMA) capability using pHOLD and pHLDA.
- CPU can address up to 512K of memory using a full 16-bit S100 address buss and the on-board bank select logic.

It provides the communication 'highway' between the CPU and the systems memory and input/output modules. A great many microcomputer standard busses exist today. Some of these have thrived because of the *de facto* acceptance by large user groups, some by their ability to support a wide variety of regular devices, and others by their technical excellence. I have chosen to interface with the S100 buss as this is currently recognised as one of the industry leaders.

The S100 buss

This originated in the USA early in 1975 in a microcomputer system manufactured by MITS. The system was called the Altair 8800 and it used a 100-pin pc board connector (50 pins a side) to provide a communications buss for an Intel 8080 CPU. The Altair Buss later became known as the 'Standard 100 Pin Buss', or S100 buss.

Recently the S100 buss has attracted the attention of the Institute of Electrical and Electronic Engineers in the USA. They have now drafted the IEEE-696 Specification for the buss, which defines the electrical and buss timing specifications for the current generation of 16-bit microprocessors. Some changes include a 16-bit bi-directional data buss and an extended 24-bit address buss. Special signals have been designated to permit the combined operation of 8-bit and 16-bit hardware. These improvements will increase the useful life of the S100 buss well into the 1990s.

The S100 buss has become one of the most commercially successful buss standards ever produced, and the multitude of S100-compatible boards has attracted the interest of both the professional and hobby computerist. Several Australian companies are currently manufacturing S100 boards and several 'kit' projects have been published in ETI. The S100 RAM Card (Project 642 from Feb. 1979) and the S100 PROM Board (Project 682 from March 1981) are compatible with this project. The S100 VDU Board (Project 640 from April 1978) and the S100 Programmable Character Generator (Project 681 from June 1980) are compatible video interface units. A suitable keyboard and cassette tape interface will be published at a later date.

The project

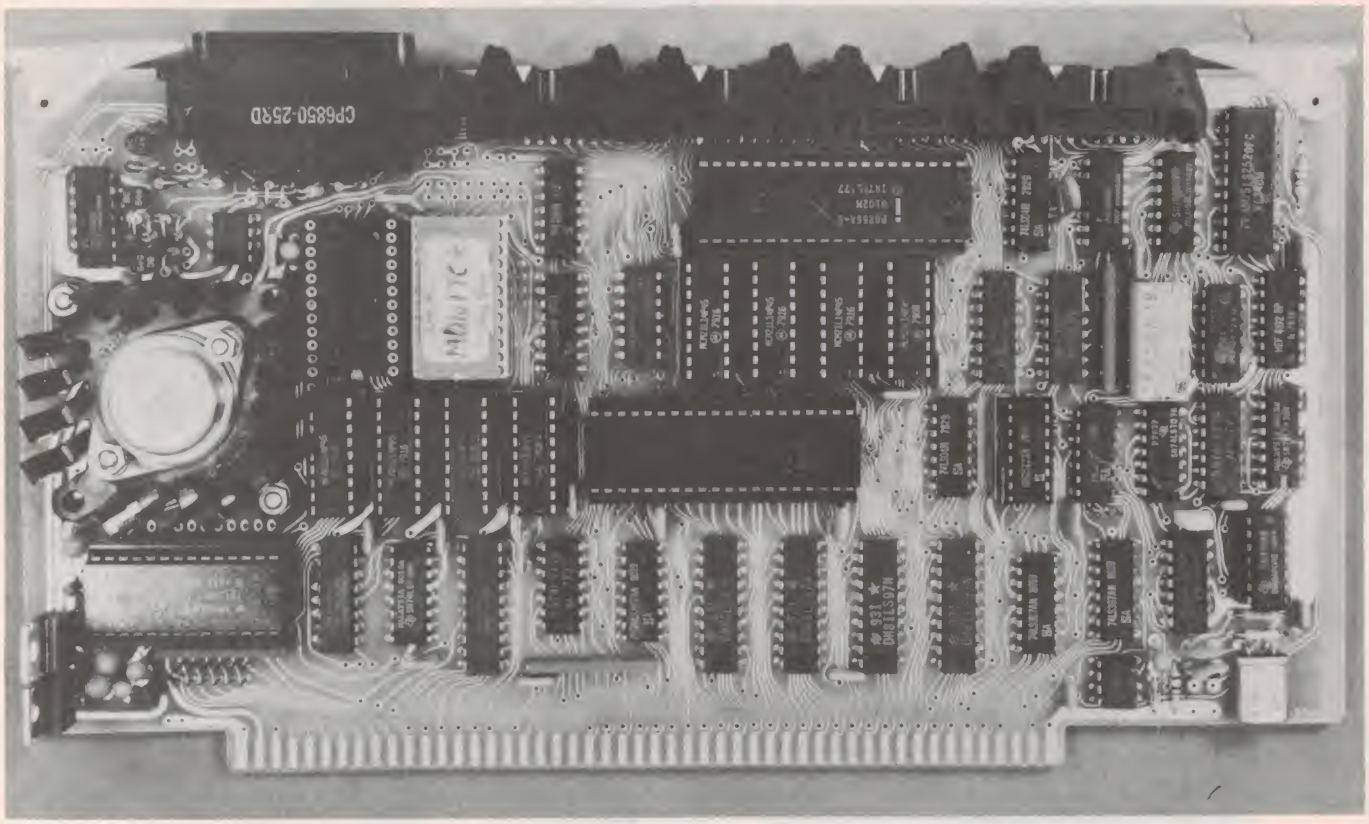
The ETI-685 has been designed as a very flexible general purpose single-board computer incorporating the Signetics 2650 8-bit microprocessor. This 2650 CPU board has been designed to interface with the well-established S100 buss structure, and this enables the user to easily expand his system's input/output and memory capabilities. This easy-to-use single-board system is a very cost-effective CPU board for OEM

IEEE-696 S100 BUSS STANDARD PINOUTS

NOTE:
H = Active high signal. L = Active low signal
(O/C) = signal driven by open collector device

PIN	NAME	LEVEL	FUNCTION
1	+8 V	-	Positive system power supply
2	+16 V	-	+16 V power supply
3	XRDY	H	Buss ready; use with pin 72
4	VI0	L(O/C)	Vectored interrupt line 0
5	VI1	L(O/C)	Ditto
6	VI2	L(O/C)	Ditto
7	VI3	L(O/C)	Ditto
8	VI4	L(O/C)	Ditto
9	VI5	L(O/C)	Ditto
10	VI6	L(O/C)	Ditto
11	VI7	L(O/C)	Ditto
12	NMI	L	Non-maskable interrupt
13	PWRFAIL	L	Indicates power failure
14	DMA3	L(O/C)	Priority bit 3
15	A18	H	Extended address bit 18
16	A16	H	Extended address bit 16
17	A17	H	Extended address bit 17
18	SDSB	L(O/C)	Disable 8 status lines
19	CDSB	L(O/C)	Disable 5 control lines
20	GND		Common with pin 100
21	NDEF		Manufacturer specification
22	ADSB	L(O/C)	Disable 16 address lines
23	DODSB	L(O/C)	Disable 8 data lines
24	PH2	H	Master buss timing signal
25	PSTVAL	L	Status valid strobe
26	PHLDA	H	Use with pin 74 to buss
27	RFU	-	Reserved
28	RFU	-	Reserved
29	A5	H	Address bit 5
30	A4	H	Address bit 4
31	A3	H	Address bit 3
32	A15	H	Address bit 15
33	A12	H	Address bit 12
34	A9	H	Address bit 9
35	DO1	H	Data out bit 1 (bidirectional bit 1)
36	DO0	H	Data out bit 0 (bidirectional bit 0)
37	A10	H	Address bit 10
38	DO4	H	Data out bit 4 (bidirectional bit 4)
39	DO5	H	Data out bit 5 (bidirectional bit 5)
40	DO6	H	Data out bit 6 (bidirectional bit 6)
41	DI2	H	Data in bit 2 (bidirectional bit 10)
42	DI3	H	Data in bit 3 (bidirectional bit 11)
43	DI7	H	Data in bit 7 (bidirectional bit 15)
44	SMI	H	Status signal (op-code fetch)
45	SOUT	H	Status signal (data to output device)
46	SINP	H	Status signal (data to input device)
47	SMEMR	H	Status signal (data from memory to buss)
48	SHLTA	H	Status signal (halt executed)
49	CLOCK	-	2 MHz signal
50	GND	-	Common with pin 100
51	+8 V	-	Common with pin 1
52	-16 V	-	Negative 16 V supply
53	GND	-	Common with pin 100
54	SCLR	L(O/C)	Reset buss slaves
55	DMA0	L(O/C)	Priority bit 0
56	DMA1	L(O/C)	Priority bit 1
57	DMA2	L(O/C)	Priority bit 2
58	SXTRQ	L	Status signal (slave request)
59	A19	H	Extended address bit 19
60	SIXTN	L	Response by slaves to pin 58
61	A20	H	Extended address bit 20
62	A21	H	Extended address bit 21
63	A22	H	Extended address bit 22
64	A23	H	Extended address bit 23
65	NDEF		
66	NDEF		
67	PHANT	L(O/C)	Phantom to disable slave devices
68	MWRT	H	With PWR for write operation
69	RFU	-	Reserved
70	GND	-	Common with pin 100
71	RFU	-	Reserved
72	RDY	H(O/C)	With pin 3
73	INT	L(O/C)	Interrupt request
74	HOLD	L(O/C)	Used with pHLDA
75	RESET	L(O/C)	Master reset
76	PSYNC	H	Control buss cycle 1
77	PWR	L	Valid data on DO buss
78	PDBIN	H	Control signal data from DI buss
79	A0	H	Address bit 0
80	A1	H	Address bit 1
81	A2	H	Address bit 2
82	A6	H	Address bit 6
83	A7	H	Address bit 7
84	A8	H	Address bit 8
85	A13	H	Address bit 13
86	A14	H	Address bit 14
87	A11	H	Address bit 11
88	DO2	H	Data out bit 2 (bidirectional bit 2)
89	DO3	H	Data out bit 3 (bidirectional bit 3)
90	DO7	H	Data out bit 7 (bidirectional bit 7)
91	DI4	H	Data in bit 4 (bidirectional bit 12)
92	DI5	H	Data in bit 5 (bidirectional bit 13)
93	DI6	H	Data in bit 6 (bidirectional bit 14)
94	DI1	H	Data in bit 1 (bidirectional bit 9)
95	DI0	H	Data in bit 0 (bidirectional bit 8)
96	SINTA	H	Status after interrupt request (pin 73)
97	SWO	L	Status signal data (transfer master to slave)
98	ERROR	L(O/C)	Status signal error (in current cycle)
99	POC	L(O/C)	Power-on-clear signal
100	GND	-	System ground

2650 sbc for S100



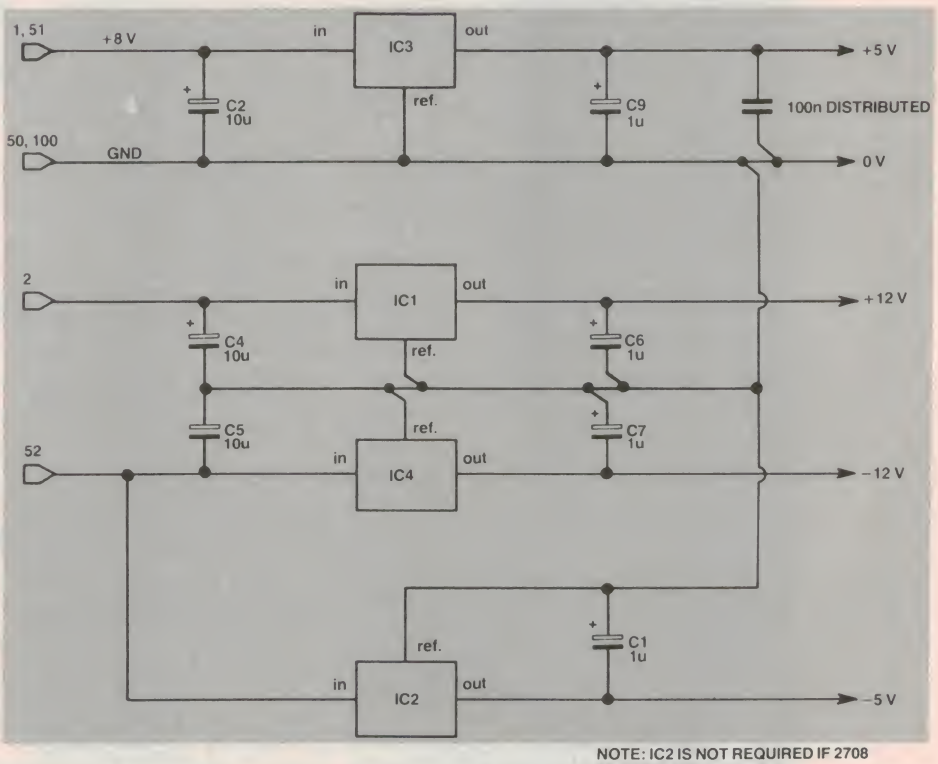
applications, 2650 enthusiasts, microprocessor students or the computer hobbyist after a powerful, expandable system well supported with projects and software.

The ETI-685 is an ideal microprocessor for the student or hobbyist who is just starting out in the world of microcomputing. Well-known author Adam Osborne describes the 2650 as "a very mini-computer-like device ... rich in memory-addressing modes and memory reference instructions". Memory addressing combinations available include absolute or relative direct addressing with optional indexing and auto-increment or decrement, and indirect addressing with optional post-indexing and auto-increment or decrement.

It may be seen from examination of the 2650 instruction set that there are many powerful instructions which are all easily understood and are typical of larger computers. This project has been designed to fully complement the capabilities of this very able microprocessor as *every mode* of memory or I/O addressing has been utilised.

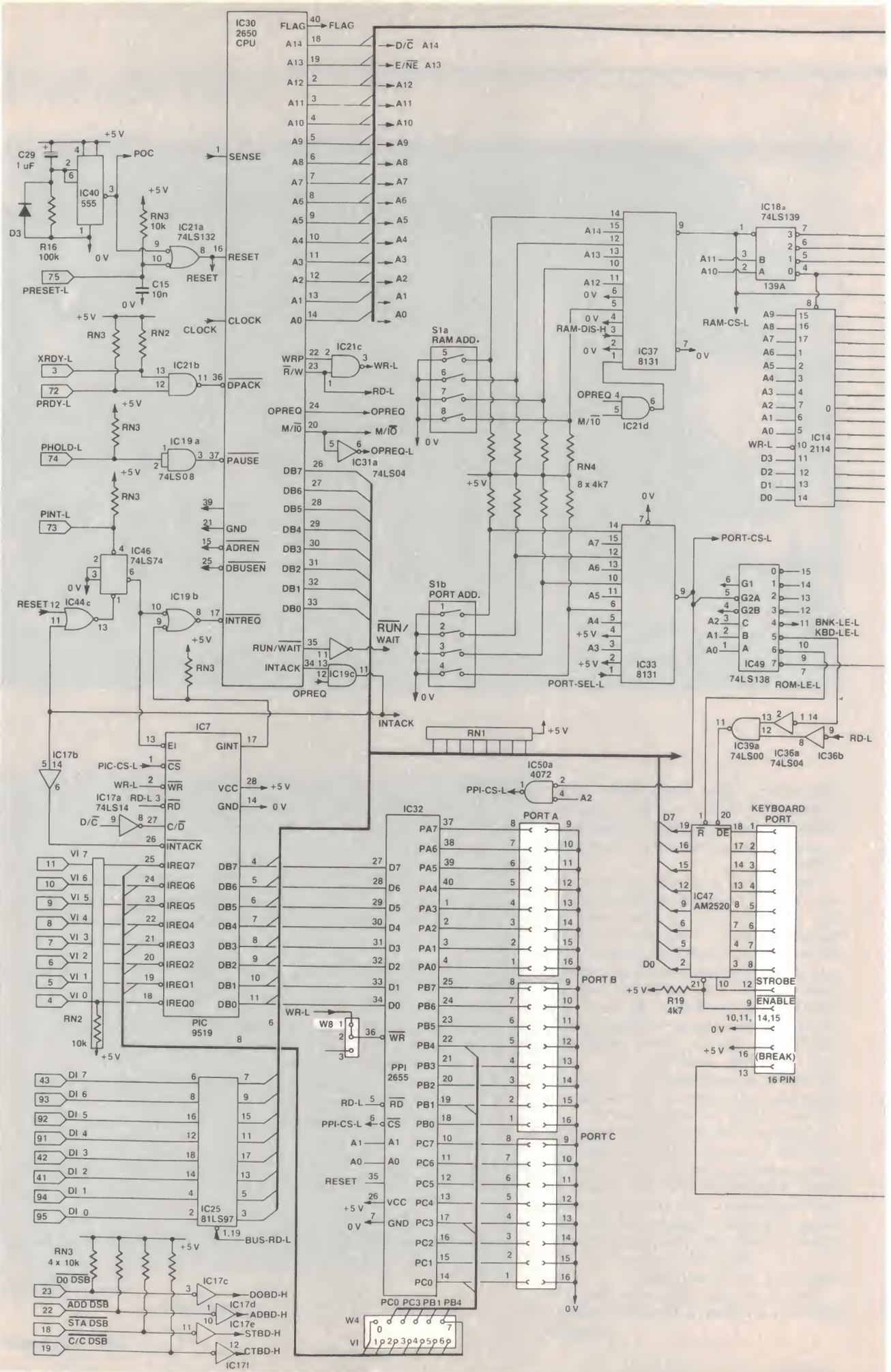
Several of the 256 extended I/O addresses are used on the CPU board to ▶

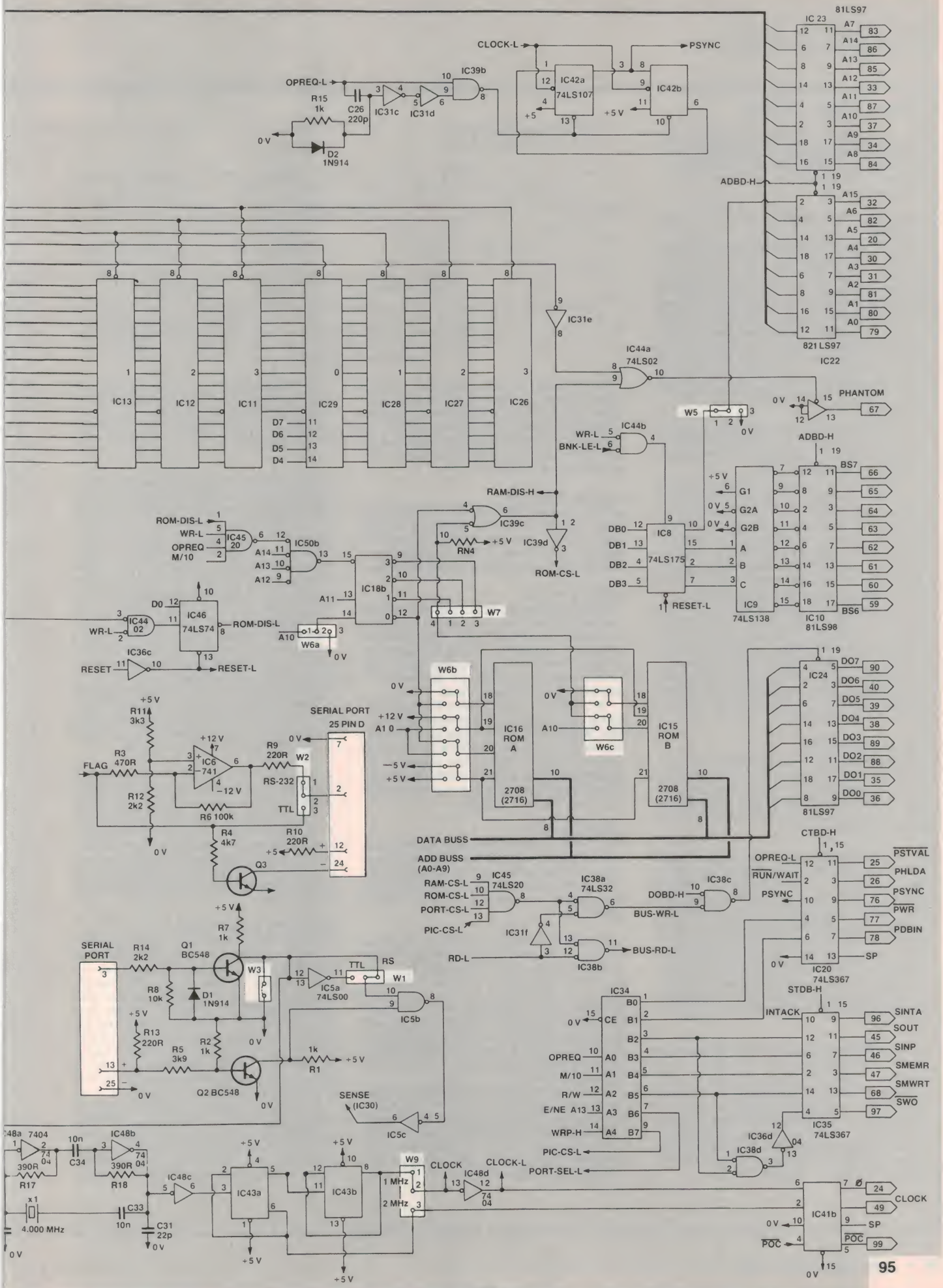
To page 99



NOTE: IC2 IS NOT REQUIRED IF 2708 EPROMS ARE NOT USED.

POWER SUPPLY


IC30
2650
CPU
FLAG
SENSE
RESET
CLOCK
DPACK
PAUSE
GND
ADREN
DBUSEN
INTREQ
RUN/WAIT
INTACK
OPREQ
WRP
R/W
WR-L
RD-L
M/IO
OPREQ-L
A14
A13
A12
A11
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
D/C A14
E/NE A13
DB7
DB6
DB5
DB4
DB3
DB2
DB1
DB0
POC
C29
1 uF
IC40
555
R16
100k
D3
C15
10n
PRESET-L
IC21a
74LS132
RN3
10k
RN2
XRDY-L
PRDY-L
IC21b
IC21c
IC19a
74LS08
PHOLD-L
PINT-L
IC46
74LS74
IC44c
IC19b
IC31a
74LS04
IC19c
S1a
RAM ADD.
S1b
PORT ADD.
RN4
8 x 4k7
IC37
8131
RAM-DIS-H
RAM-CS-L
IC18a
74LS139
139A
IC14
2114
OPREQ
IC21d
IC33
8131
PORT-SEL-L
PORT-CS-L
IC49
74LS138
BNK-LE-L
KBD-LE-L
ROM-LE-L
IC39a
74LS00
IC36a
74LS04
IC36b
RD-L
RN1
IC50a
4072
PPI-CS-L
IC7
PIC
9519
IC17a
74LS14
IC17b
PIC-CS-L
IC32
PPI
2655
PORT A
PORT B
PORT C
IC47
AM2520
KEYBOARD
PORT
R19
4k7
STROBE
ENABLE
(BREAK)
16 PIN
W8
W4
RN2
10k
RN3
4 x 10k
IC25
81LS97
BUS-RD-L
DO DSB
ADD DSB
STA DSB
C/C DSB
DOBD-H
ADBD-H
STBD-H
CTBD-H
IC17c
IC17d
IC17e
IC17f


CLOCK-L
PSYNC
OPREQ-L
IC39b
IC42a
74LS107
IC42b
R15
1k
C26
220p
IC31c
IC31d
D2
1N914
IC23
81LS97
ADBD-H
IC22
821 LS97
IC31e
IC44a
74LS02
IC13
IC12
IC11
IC29
IC28
IC27
IC26
D7
D6
D5
D4
W5
PHANTOM
WR-L
BNK-LE-L
IC44b
RAM-DIS-H
ROM-DIS-L
WR-L
OPREQ
M/10
IC45
20
IC50b
A14
A13
A12
IC39c
IC39d
RN4
ROM-CS-L
IC18b
A11
A10
W6a
W7
IC44
02
IC46
74LS74
RESET
IC36c
RESET-L
DB0
DB1
DB2
DB3
IC8
74LS175
RESET-L
G1
G2A
G2B
A
B
C
IC9
74LS138
IC10
81LS98
BS7
BS6
W6b
W6c
IC16
ROM
A
2708
(2716)
IC15
ROM
B
2708
(2716)
IC24
81LS97
DO7
DO6
DO5
DO4
DO3
DO2
DO1
DO0
SERIAL PORT
25 PIN D
R11
3k3
R3
470R
FLAG
IC6
741
R12
2k2
R6 100k
R9
220R
W2
RS-232
TTL
R10
220R
R4
4k7
Q3
DATA BUSS
ADD BUSS
(A0-A9)
CTBD-H
OPREQ-L
RUN/WAIT
PSYNC
PSTVAL
PHLDA
PSYNC
PWR
PDBIN
SP
IC20
74LS367
RAM-CS-L
ROM-CS-L
PORT-CS-L
PIC-CS-L
IC45
74LS20
IC38a
74LS32
IC38c
DOBD-H
BUS-WR-L
IC31f
RD-L
IC38b
BUS-RD-L
R7
1k
SERIAL PORT
R14
2k2
Q1
BC548
W3
R8
10k
D1
1N914
R13
220R
R5
3k9
R2
1k
Q2 BC548
IC5a
74LS00
TTL
RS
W1
IC5b
R1
1k
SENSE
(IC30)
IC5c
IC34
CE
OPREQ
M/10
R/W
E/NE A13
WRP-H
PIC-CS-L
PORT-SEL-L
STDB-H
INTACK
SINTA
SOUT
SINP
SMEMR
SMWRT
SWO
IC35
74LS367
IC36d
IC38d
IC48a 7404
IC48b
IC48c
IC48d
R17
390R
R18
390R
C34
10n
C33
10n
C31
22p
x1
4.000 MHz
IC43a
IC43b
W9
1 MHz
2 MHz
CLOCK
CLOCK-L
IC41b
POC

HOW IT WORKS — ETI 685

This is a detailed functional description of the project and not a 'pulse-by-pulse' description of its operation. Reference to data books for relevant ICs (especially the 2650) is recommended.

CENTRAL PROCESSOR UNIT (CPU) AND CLOCK

The CPU used is the Signetics single-chip 8-bit NMOS microprocessor, the 2650A. This processor has been designed to closely resemble conventional binary computers and executes variable length instructions of from one to three bytes in length. This CPU contains a total of eight general purpose registers, each eight bits long. Any register may be used as the source or destination for arithmetic operations, as index registers, and for I/O data transfers. The 2650 has a 15-bit parallel address buss and can address up to 32 768 bytes (32K) of memory.

The 2650 includes a very versatile set of I/O instructions which provide it with 256 extended I/O addresses, two non-extended ports and a special single-bit I/O facility.

The project comprises an internal 8-bit bi-directional data buss, 15-bit address buss and several control signals which interconnect the 2650 CPU to the on-board RAM and ROM memory, ports and the S100 buss buffers. A programmed 32 x 8 fuse-link PROM is used to generate the S100 buss control signals from the 2650's control signals, required for external S100 memory and I/O data interchange.

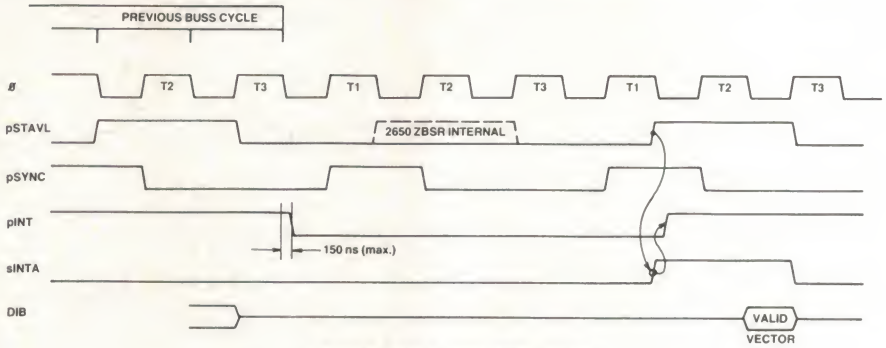
A 4 MHz quartz crystal oscillator formed by IC48a, b and c provides the basic timing element for the CPU and the entire S100 buss computer. This frequency is divided by IC43 to produce the 2 MHz and 1 MHz clocks required for the CPU and the S100 buss CLOCK (pin 49) and ϕ (pin 24) signals. The wire link, W9, is used to change the CPU clock to 2 MHz for the high-speed 2650A-1 processor.

ON-BOARD MEMORY

The Signetics 2650 microprocessor can address directly 32K of memory via its 15 address lines and, following a 'reset', reads its first instruction from address '0000'H. It is therefore customary to locate the system EPROM monitor to start at this address.

1. EPROM MEMORY: Provision has been made on the board for the use of either single (+5 V) or multirail (+5, +12, −5 Volt) type EPROMs in either 1K (2708/2758) or 2K (2716) increments. Two EPROM sockets have been provided, so the board can accommodate 1K, 2K or 4K of EPROM memory, with the first EPROM (IC16) addressed to '0000'H. The wire link set, W7, selects the location of the second EPROM, and W6 adjusts the pin configuration for the EPROM family in use. These links are preset for a single 2708-type EPROM, which will carry the monitor program.

2. RAM MEMORY: The ETI-685 has provision for 4K of on-board RAM using eight 2114 memory chips. This block of RAM can be addressed to any 4K boundary within the 32K 2650 memory map by switches 5, 6 and 7 of SW1, or it can be disabled completely by switch 8. These four switches work in conjunction with the octal comparator (IC37) to select the RAM block address, and the 1-of-4 decoder (IC18a) generates the RAM chip-select signals.



INTERRUPT (NON-VECTORED) TIMING DIAGRAM

The on-board EPROM has been given a higher priority than the RAM, and the gate IC39b inhibits the 'reading' of all RAM switched to occupy the same address. For example, if a 1K EPROM (i.e: monitor) and the RAM are both switched to start at '0000'H, the usable RAM will commence at '0400' H.

MEMORY PHANTOM

Both the on-board EPROM and RAM exercise a higher priority over the remaining system memory map and generate the PHANTOM signal on S100 buss pin 67 to deselect any external memory occupying the same address.

EPROM DISABLE

A facility has been provided where the selected on-board EPROM may be disabled, providing continuous RAM from '0000'H. The EPROM is disabled by writing '01'H to the applicable I/O address, which sets the flip-flop IC46b. The EPROM is returned by writing a '00'H to the I/O address or by a processor reset.

This feature is very useful for testing programs which have been written for operation from address '0000'H. It should be noted that even with the EPROM enabled it is possible to load (i.e. Write or Block Move) programs into the RAM, which is co-resident with the EPROM; however, you can only read (or run) the program when the EPROM is disabled.

ON-BOARD PORTS

The ETI-685 has been provided with five ports to give the user a wide variety of interface input-output devices without the need for additional I/O boards. Three ports are programmable, one port is serial and the fifth is a latched 8-bit parallel port.

1. THE PROGRAMMABLE PORTS: The three programmable ports (A, B and C) are provided by way of a single 40-pin LSI device (IC32) called the PPI (Programmable Peripheral Interface). This IC is addressed as four consecutive extended port addresses. The first three addresses access the A, B and C port registers and the fourth address is the Control Register. The PPI has three modes of operation, selected by writing the appropriate control word into the Control Register.

In MODE 0 the PPI provides simple input and output for the three 8-bit ports. MODE 1 provides for strobed input and output data transfer from ports A and B with 'handshaking' signals supplied by port C. In MODE 2 the A port is structured as an 8-bit bi-directional port with handshaking supplied by port C.

The Signetics 2655 PPI provides two additional features over the standard 8255 PPI. The B port may be configured for 8-bit serial-to-parallel or parallel-to-serial communications and, in the 2655, the B port contains a 16-bit timer.

2. THE SERIAL PORT: The serial port is supported by the 2650's single bit I/O facility via the Flag and Sense pins. These two CPU pins are connected directly to the processor's Program Status Word register and can be processed by software to provide a variety of serial communication formats. The monitor (Multibug) uses this port for 300 Baud ASCII serial communications, for keyboard input and CRT output, and for 300 Baud binary serial communications to the cassette tape interface. With suitable software, the port can be used to perform any form of data communication including *music and Morse code generation!*

The Flag and Sense pins of the CPU are buffered on the board and are made available at the serial port at EIA RS-232C voltage levels and as a current loop. The EIA RS-232C voltage levels can optionally be converted to TTL levels by rewiring the wire links W1 and W2.

3. THE PARALLEL PORT: The parallel port is supported by a single TTL octal latch which is similar in operation to the standard 74LS373. The latch used, however, is the AM25LS2520 (IC47) which features an additional asychronous 'clear input' signal. This port is read and reset by addressing the appropriate 2650 extended port. The monitor uses this port as the keyboard input when the 'memory-mapped VDU' monitor is being used.

INTERRUPT CONTROLLER

The project uses the powerful AM9519 Universal Interrupt Controller (IC7) to process eight maskable interrupt inputs. This controller has been designed as a general purpose interface and can be used by most popular 8-bit microprocessors. The AM9519 manages up to eight maskable interrupt inputs, resolves priorities and issues an 'interrupt request' to the CPU. When the CPU responds with an 'interrupt acknowledge' the controller outputs a one-to-four byte response associated with the highest priority unmasked interrupt request.

For the 2650 CPU the AM9159 should be programmed for only one response byte, and the eight response bytes are pre-loaded into only eight locations within the 8 x 32 internal read/write response memory. All communication with the Interrupt Controller is by way of

the 2650's non-extended C and D ports. The C port addresses the Control input for loading the Command Register and reading the Status Register, and the Data read or write transfers to or from the selected internal registers or memory locations are performed via the D port.

NON-VECTORED INTERRUPTS

The S100 non-vectored Interrupt Request (pINT) on buss pin 73 is also supported on the board. This input, when pulled low, sets the flip-flop IC46a and generates a 2650 INTREQ. When this interrupt occurs, the 2650 will complete its current instruction, set the interrupt inhibit bit in the PSW and generate an S100 sINTA ('interrupt acknowledge') signal on buss pin 96. On receipt of sINTA the interrupting device must output the 8-bit vector onto the data-in buss. The flip-flop IC46a is reset automatically when the CPU generates sINTA.

This interrupt request (pINT) has been allotted a higher priority than the eight vectored interrupts managed by the PIC.

MONITOR

A 2716 2K, single-rail EPROM containing two 1K monitor programs is available for use with this project. The EPROM has been written to support either serial communications or memory-mapped video terminals by selecting the appropriate 1K monitor. The EPROM-type link field is set up for a 2758 single-rail 1K EPROM, and the A10 address pin is wired to either 0 V or +5 V to select the required 1K monitor.

Both monitor programs have been styled on the BINBUG monitor and their commands are compatible to BINBUG and the Signetics PIPBUG monitors. The SERIAL MONITOR communicates at 300 Baud via the 2650 Flag and Sense pins and contains a few new subroutines to erase the VDU screen and print a sign-on message. The MEMORY-MAPPED MONITOR differs only from BINBUG in the keyboard-in subroutine, which now utilises the SBC 8-bit parallel port.

BANK SELECT

The ETI-685 incorporates a bank select facility to extend the 2650's maximum address range to 512K of memory. This is accomplished by first generating a sixteenth address bit to provide an address range of 64K, and then providing a one-of-eight bank (of 64K) select. A quad latch, addressed as one of the on-board decoded extended addresses, is used to store four bits of data. The least significant bit is used as the sixteenth S100 address bit (A15), and the other three bits are presented to a 74LS138 one-of-eight decoder. The eight outputs of the decoder are buffered and appear on the S100 buss on pins 59 to 66 inclusive. If the bank select feature is not required the 74LS138 and the tri-state buffer can be omitted.

S100 SIGNAL GENERATION AND TIMING

An 82S123 fuse-link PROM (IC34) is used to synthesise seven of the eleven S100 control and status signals generated on the board. This PROM has as its inputs the five 2650 control signals — OPREQ, WRP, $\overline{R}$/W, M/$\overline{IO}$ and E/$\overline{NE}$.

The 2650 'operation request' (OPREQ) output signal is the coordinating signal for all external CPU operations. As this signal validates (or qualifies) all data, address and control lines from the 2650 it is 'ANDed' in the PROM with the other four CPU control signals. The OPREQ signal is used to generate the S100 control signal pSTVAL (Processor Status Valid).

The Write Pulse (WRP) output is a timing signal from the CPU that provides a positive-going pulse in the middle of each memory or I/O write operation. It is designed to be used as a timed Write Strobe generated after the address and data lines have stabilised. In the fuse-link PROM this signal is used to generate the S100 control signal, PWR.

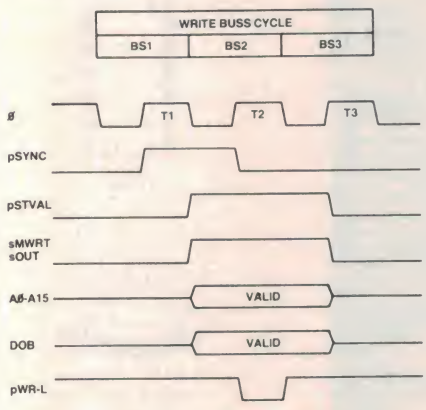
The processor Read/Write ($\overline{R}$/W) output defines whether the external operation is a read or a write, and the Memory I/O (M/$\overline{IO}$) output defines whether the operation is for memory or I/O. These signals are gated in the PROM to produce the S100 sMEMR, sINP, sMWRT and sOUT signals. As $\overline{R}$/W also indicates in which direction the data flow is, it is also used to generate pDBIN and to control the on-board data-buss transceivers.

The Extended/Non-Extended (E/$\overline{NE}$) 2650 output is the operation control signal that is used to discriminate between the two-byte extended and the one-byte non-extended I/O operation. On the ETI-685 the C and D non-extended I/O addresses are used for communicating with the on-board Interrupt Controller and they are not presented to the S100 buss. The extended signal is used in the PROM to qualify the S100 I/O status signals sINP, sOUT and sWO.

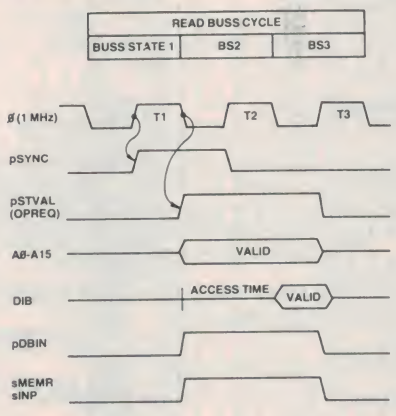
The S100 control signal pSYNC is defined as indicating the start of a new buss cycle and was initially used to strobe the status latches of external circuitry. These latches stored the 8080's status information which was present on its data lines at this time. As several modern memory boards use pSYNC pulses (e.g: to generate 'wait states') this S100 control signal has been synthesised on the ETI-685. A modulo-3 counter synchronised by OPREQ is used to generate a pulse every three CPU clock cycles. This pulse is one clock period long, and is timed to rise midway through the first buss cycle.

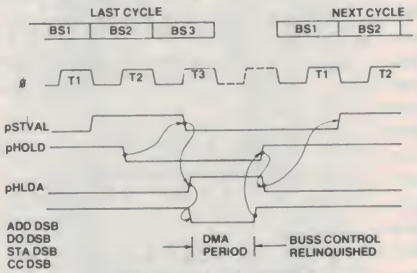
The S100 CLOCK signal is a 2 MHz clock, and the phi (ϕ) signal is the same frequency as the CPU clock (as selected by W9). A Power-On-Clear (POC) signal is generated onboard and can be used to reset 'slave' devices. The Status signal sINTA is the 2650 INTACK, and the pHLDA is the 'WAIT' CPU signal.

Refer to the *S100 buss timing diagram* for a graphical representation of the timing of these Status and Control signals.



S100 BUSS TIMING DIAGRAM





DMA SEQUENCE TIMING DIAGRAM

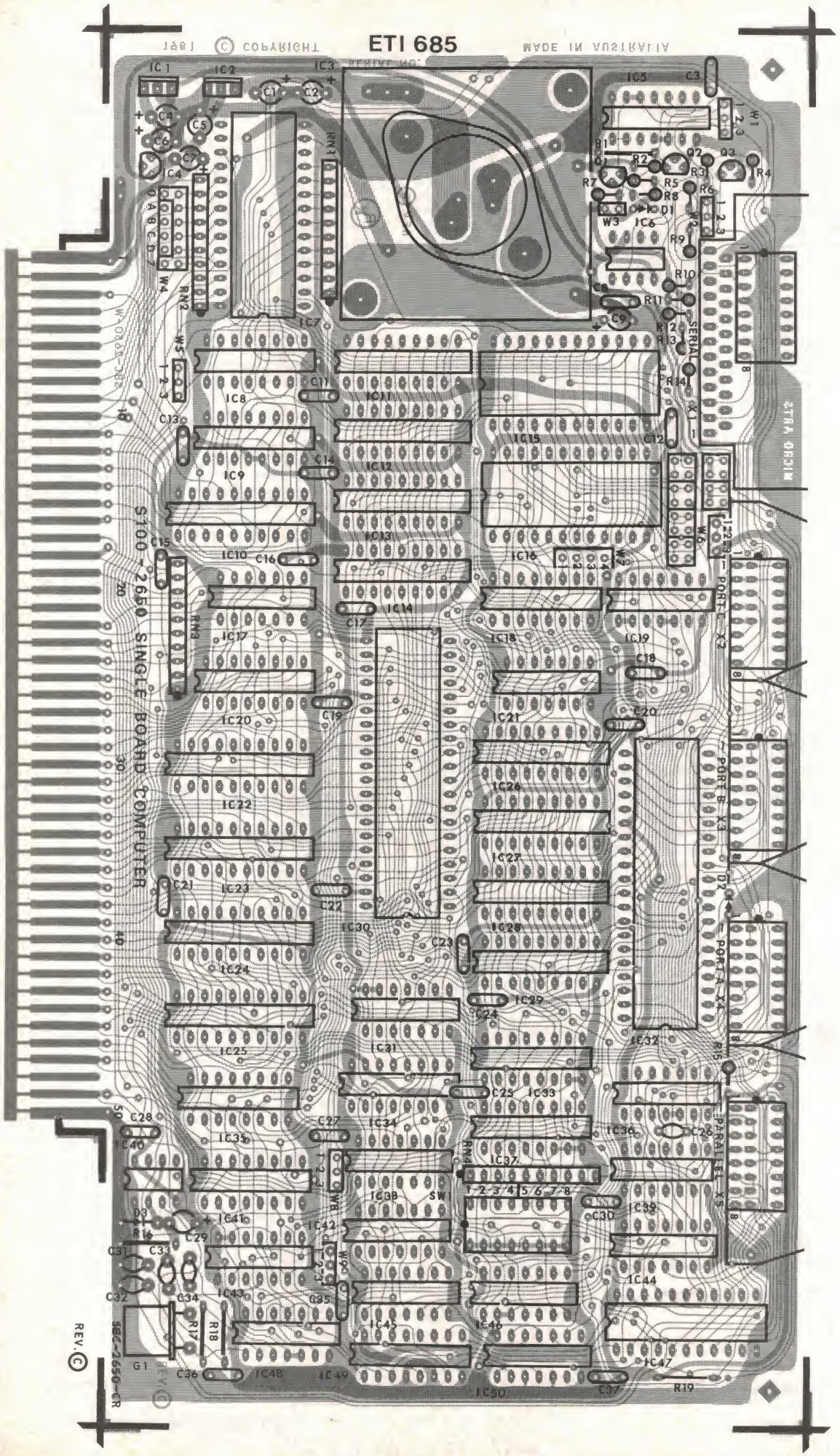
DIRECT MEMORY ACCESS (DMA)

The temporary transfer of buss control from the Buss Master to a Temporary Buss Master for that device to execute a direct memory read or write is referred to as 'Direct Memory Access'. In order to avoid conflict during this transfer of buss control, a predetermined sequence of events exists which is called the DMA Cycle. The exchange of buss control to the DMA device and the subsequent return of control to the CPU (Buss Master) is accomplished by the S100 pHOLD and pHLDA signals.

On the ETI-685 board the pHOLD S100 signal (pin 74) is connected to the 2650 Pause line. When this signal is active the CPU completes its current instruction and enters the WAIT state. It indicates when this condition exists by sending the RUN/$\overline{WAIT}$ status output 'low', and this action generates the S100 pHLDA signal (pin 26). The receipt of pHLDA by the DMA device indicates that it may assert ADSB, DODSB and SDSB, which disables (tri-states) the CPU address, data-out and status buss-buffers. The final transfer of buss control is effected with the assertion of CDSB, which disables the CPU control buss-buffer.

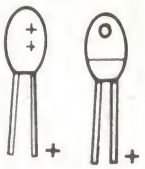
The Temporary Buss Master is now in full control of the buss, and will maintain this condition to the end of its DMA cycle. Return of control to the Buss Master is almost the 'mirror image' of events, with the final transfer of control accomplished with the removal of the pHOLD signal by the DMA device.

Refer to DMA *sequence timing diagram* for a graphical representation of a DMA Cycle.



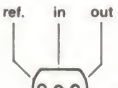
COMPONENT PINOUTS

Capacitors



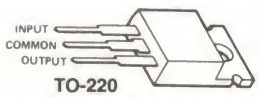
tantalum

DIODES

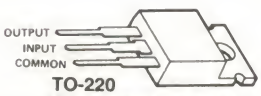


TO-92

79LXX
bottom view



TO-220
78xx +ve voltage reg.

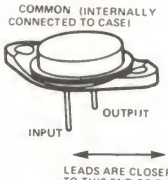


TO-220
79xx −ve voltage reg.

TO-92

BC548, BC108

ICs



TO-3

+ve voltage reg.

From page 93

access the on-board programmable ports, and the control and data non-extended I/O instructions are used to communicate with the programmable Interrupt Controller. This Interrupt Controller will provide the user with a full understanding of interrupt handling procedures.

Construction

The pc board designed for this project is a double-sided type with plated-through holes. We recommend you use a commercially made board for no other reason than that it goes a long way towards ensuring success with the project. If you have access to the appropriate equipment and have enough experience to feel confident in making your own double-sided board, then prints of the pc board pattern are available from us — with the usual proviso that you will only be making one for your own use and not for resale. Note that breach of copyright is now a criminal offence. The board design is copyright to the author, who has licensed Applied Technology to manufacture them. Apart from selling them retail, we understand Applied Technology will wholesale boards to other suppliers.

If you want to make your own board, then send a large (at least 250 x 300 mm) stamped, addressed envelope to:

ETI-685 PCB
ETI Magazine
15 Boundary St
Rushcutters Bay NSW 2011

We will return a same-size positive print of the front and rear pc board patterns.

With the pc board and all the components in your possession, the first step is to install all the IC sockets in their correct positions. It is recommended that you use sockets for the two EPROM positions (ICs 15 and 16), the 2650 CPU (IC30), all the RAM chips (ICs 11, 12, 13 and 14 plus ICs 26, 27, 28 and 29), IC7 (the PIC), IC32 (the 8255 PPI), IC43 (though one is not shown in our picture) and IC48. These are all located on the component side ('front'). Take care to orient them correctly. On those oriented 'vertically', pin 1 faces 'down' (toward the S100 connector). Those oriented 'horizontally' face the right hand side of the board, when viewed from the component side with the S100 connector facing down.

For the ports — marked X1, X2, X3, X4 and X5 — you have the option of installing dual-in-line sockets or the appropriate right-angle connectors (as shown in the photograph of the prototype).

A little tip — when installing IC sockets, solder one pin on each end of the socket and check that the socket is flat against the board. If necessary, reheat the solder and push the socket against the board. When all sockets are 'tacked' in flat, finish soldering all the other pins.

Install all the resistors next. Pre-bend the leads of each resistor using a pair of long-nosed pliers before inserting them into the board. Note that R2 to R15 are mounted vertically.

Install the four resistor networks (RN1, 2, 3 and 4). Note that pin 1, identified by a 'dot' on the resistor network, is located as indicated on the component overlay.

Now install all the capacitors. Take note of the polarity of the tantalum capacitors.

Follow with diodes D1, D2 and D3; D1 and D2 are mounted vertically. Take note of their polarity, also.

Next comes the crystal. Carefully preform the leads with a pair of long-nosed pliers and apply an 8 mm-square piece of double-sided tape to the back of the crystal before installing it on the board. When soldering, do not apply excessive heat.

At this stage, check with a multimeter that there is not a short circuit between any voltage rail and 0 V. Measure at the regulators IC1, 2, 3 and 4 between the input and output to ground for any short circuits. Locate and rectify any 'shorts' found before proceeding any further.

Now you can install the voltage regulators IC1, IC2, IC3 and IC4. IC3 is mounted on a large, finned heatsink which must be spaced above the board. Mount four M3 10 mm screws onto the pc board, with four nuts on the top of the board acting as spacers. Fit the heatsink onto the four screws and, after checking that the IC holes are the right way, secure the heatsink with two nuts to the outside screws. Apply heat conductive silicon paste to the underside of IC3 and mount it onto the heatsink. Secure with two nuts and solder the two pins.

Now it is prudent to check power supply operation. Apply power and verify with your multimeter that the outputs of the voltage regulators are within ± 5% (e.g: 5.2 to 4.8 V for IC3). ▶

PARTS LIST—ETI-685

Resistors ..... all ½W5%
R1, 2, 7, 15 ..... 1k
R3 ..... 470R
R4, 19 ..... 4k7
R5 ..... 3k9
R6, 16 ..... 100k
R8 ..... 10k
R9, 10, 13 ..... 220R
R11 ..... 3k3
R12, 14 ..... 2k2
R17, 18 ..... 390R
RN1, 2, 3, 4 ..... 4k7 x 9 SIP resistor networks

Capacitors
C1, 6, 7, 9, 29 ..... 1u/6 V tant.
C2, 4, 5 ..... 10u/6 V tant.
C3, 8, 10-25, 27, 28, 30, 35-37 ..... 100n ceramic
C26 ..... 220p ceramic
C31, 32 ..... 22p (see text)
C33, 34 ..... 10n ceramic

Semiconductors
D1, 2, 3 ..... 1N914A, 1N4148A
Q1, 2, 3 ..... BC108, BC548
IC1 7812
IC2 7905
IC3 ..... LM323K
IC4 ..... 79L12
IC5, 39 ..... 74LS00
IC6 741
IC7 ..... AM9519PC (PIC)
IC8 ..... 74LS175
IC9, 49 ..... 74LS138
IC10 ..... 81LS98
IC11-14, 26-29 ..... 2114L-4
IC15, 16 ..... 2708/2716 (one monitor, one spare)
IC17 ..... 74LS14
IC18 ..... 74LS139
IC19 ..... 74LS08
IC20, 35, 41 ..... 74LS367
IC21 ..... 74LS132
IC22-25 ..... 81LS97
IC30 ..... 2650A (CPU)
IC31, 36 ..... 74LS04
IC32 ..... 2655:8255A (PPI)
IC33, 37 8131
IC34 ..... 82S123
IC38 ..... 74LS32
IC40 555
IC42 ..... 74LS107
IC43, 46 ..... 74LS74
IC44 ..... 74LS02
IC45 ..... 74LS20
IC47 ..... AM25LS2520
IC48 7404
IC50 4072

Miscellaneous
X1 ..... 4.000 MHz crystal
SW1 ..... 8-way SPST DIP switch
ETI-685 pc board (see text); pc-mount T0-3 heatsink — Thermalloy type THM6051B or 6001B-2 or similar; DIP sockets — 2 x 8-pin, 15 x 14-pin, 15 x 16-pin; 8 x 18-pin, 5 x 20-pin, 1 x 22-pin, 2 x 24-pin, 1 x 28-pin, 2 x 40-pin; nuts, bolts etc.; two pc board ejectors — e.g: Cambion No. 415 7036 01 00 20 or similar.

Optional connectors: The following connectors may be used in lieu of 16-pin DIP sockets: 1 x 25-pin 90° pc-mount 'D' connector (CP6850-25RD); 3 x 10-pin 90° headers (e.g: Hirose HIF3-10P-2.54DS or sim.); 1 x 16-pin 90° header (e.g: Hirose HIF3-16P-2.54DS or sim.).

Price estimate

We estimate the cost of purchasing all the components for this project will be in the range:

$200—$230

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project, such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel supplied (if used), etc — whether bought as separate components or made up as a kit.

If all is well, remove power and clean the flux off the rear of the board with flux cleaner or methylated spirits.

Before proceeding with installation of the ICs onto the board it is advisable to check the data and address buss lines for shorts. Any shorts on these lines will prevent the board from operating and can make fault finding very difficult. An ohmmeter or small buzzer can be used to check for shorts. Place one probe on the first data or address line at the CPU socket (IC30) and touch the other probe across the remaining lines in turn. No continuity should be found. Move the fixed probe to the next line and repeat the process until all lines have been checked.

Install IC43 and 48 into their respective sockets. Apply power to the board and, with the aid of a logic probe or CRO, verify that the 1 MHz clock appears at pin 38 of IC30 and pin 6 of IC41.

Install the following ICs: 5, 13, 17, 18, 19, 21, 28, 30, 33, 36, 37, 40, 44, 45, 46, 49 and 50. The board now contains sufficient components to operate as a 'minimum component system' with 1K of user RAM available from '0400'H to '07FF'H. The board can be operated and tested using a serial VDU with communications via the current loop. A serial VDU monitor in 2708 EPROM must be installed at IC16. If the 2716 dual SBC monitor is to be used, the W6 wire link field must be rewired, as illustrated in the wire-link diagrams. The SBC Monitor requires the keyboard to be wired to the parallel port at socket X5.

The successful operation of the project at this point will indicate that all the internal data, address and control busses are without fault and you may proceed to install the on-board ports, extra RAM and the S100 buss buffers.

If a serial VDU is not available, this intermediate test cannot be performed, so proceed to the next step.

Install the following ICs: 6, 11, 12, 14, 20, 22, 23, 24, 25, 26, 27, 29, 31, 34, 35, 38, 39, 41, 42 and 47. The board is now complete and can be installed onto an S100 buss mother board.

A 'BINGUG' 2708 Monitor can be isnerted into IC16 to enable the use of the 640 VDU. If the dual SBC monitor or any other program in 2716 EPROM is to be used, ensure that the W6 link field has been rewired accordingly.

The ETI-685 can now be tested on the S100 buss with additional RAM memory. To verify that the system is fully operational, load and execute the RAM-TEST program given on page 104.

Next, you can install the PPI (IC32) and the PIC (IC7 — optional). Verify that the PPI is operational by loading and executing the PPI-TEST Program on page 104. Note that external hardware (an octal DIP switch and pull-up resistors) will be required to connect to the port under test.

The Multibug Monitor

The Monitor is a peripheral interface program, resident in non-volatile ROM or EPROM, which provides the user with a basic set of operating commands. This program is resident at address '0000'H, and is executed by a CPU 'reset'.

The ETI-685 can be operated with any monitor program which commences at address '0000'H. In most cases one of three monitors will be used. Firstly, there is the Signetics' PIPBUG monitor (transferred into EPROM) for serial VDUs, then there is the range of BINBUG monitors (produced by MicroByte) for S100 memory-mapped VDUs and thirdly, the SBCBUG monitor.

The SBCBUG is a 2716 2K single-rail EPROM containing two 1K monitor programs. The EPROM has been written to support either serial communications or memory-mapped video terminals by selecting the appropriate 1K monitor. The EPROM-type link field is set up for a 2758 single-rail 1K EPROM, and the A10 address pin is wired to either 0 V or +5 V to select the required 1K monitor (see later).

Both monitor programs have been styled on the BINBUG monitor and their commands are compatible to the BINBUG and PIPBUG monitors. The original PIPBUG monitor supported seven basic commands, each selected by a single alpha character, and these have been retained. The SERIAL MONITOR communicates with the VDU at 300 Baud via the 2650 Flag and Sense pins, and contains a few new subroutines to erase the VDU screen and print a sign-on message. The MEMORY-MAPPED MONITOR differs only from BINBUG in the keyboard-in subroutine, which now utilises the on-board 8-bit parallel port.

Monitor commands

Following are the commands and their respective functions:

A — Examine and **A**lter memory contents.
B — Set a program **B**reakpoint.
C — **C**lear a set breakpoint.
D — **D**ump a block of memory to tape (300 Baud binary).
G — Execute a program at a specified **'Go'** address.
L — **L**oad a tape file into memory.
S — Examine (**S**ee) and modify the CPU registers.

Now let us look in detail at each command and what they do.

Examine and alter memory: This command provides the user with a means of *displaying* the contents of a specified memory location and *altering* ▶

MONITOR SUBROUTINE SUMMARY

The monitor is included in the microcomputer system to provide the user with a basic set of operating peripheral interface commands. Many of the program subroutines contained in the monitor can be incorporated into user programs, and their use will greatly simplify interface programming requirements.

The following subroutine descriptions have been compiled to give the programmer a brief explanation of the function of each subroutine, details of the CPU registers affected and the maximum level of subroutine nesting achieved by each subroutine. The subroutines are listed in 'name' alphabetical order. The subroutines are only available in either the Serial or Memory-Mapped VDU Monitors.

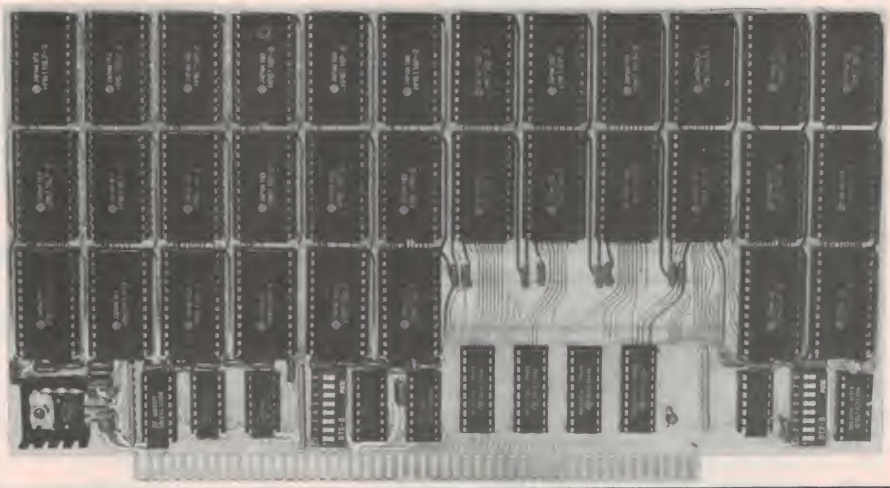
Name	Address	Nest	Description
AGAP	027D	3	Outputs 'the number in Register 3' spaces (H'20').
BIN	0224	3	Inputs two hexadecimal characters from the keyboard and forms as one 8-bit byte in register R1. Serial monitor only.
BOUT	0269	3	The byte in R1 is output in binary as two hexidecimal characters.
CHIN	0286	3	An ASCII character is input to R0 from the keyboard.
COUT	02B4	2	The byte in R0 is output as an ASCII character.
CRLF	008A	3	Outputs a carriage return and line feed to VDU.
DLAY	039B	1	Produces a 1-bit delay at 300 Baud (approx. 3.3 ms).
DLY	039F	1	Produces a half-bit delay at 300 Baud (approx. 1.6 ms).
FORM	027B	3	Outputs three spaces (H'20') to the VDU.
GNUM	02DB	2	Places the next entry in the line buffer into R1 and R2. It ignores leading zeros and correctly interprets a 1, 2, 3 or 4-character entry.
INCT	00AB	1	Adds the two-byte number stored at TEMP and TEMP+1 to R1 and R2 (with carry) and stores the two-byte result back in TEMP and TEMP+1.
LINE	005B	3	Inputs up to 20 characters from the keyboard into the Line buffer. 'Delete' is used for entry corrections and CR or LF terminates the routine.
LKUP	028C	1	Converts an ASCII character in R0 into a hex value in R3. Generates an error message if a character is not hexadecimal.
STRT	00A4	1	Stores the number in R1 and R2 in TEMP and TEMP+1.

APPLIED TECHNOLOGY

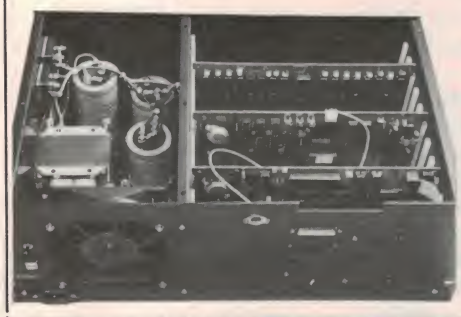
MEGAMEMORY – state of the art 64K static ram card – 4W power

Now you can afford the finest static memory card money can buy. This incredible board uses revolutionary new CMOS static RAM chips (6116 2KX8).The result;- High speed (4MHz), ultra low power consumption (4W max. with 64K) and low cost.For reliable memory on the S100 bus, static memory is a must, and MEGAMEMORY gives it to you at a price which makes other static boards look really overpriced. MEGAMEMORY complies with IEEE 696 S100 bus and can be bank selected to any of 16 64K blocks.The board is configured as 8 separate 8K blocks with the last block further divided into four 2K 'windows'. Another world first from AT; and designed right here in Australia!

32K Built and tested	**$325.00**
48K Built and tested	**$425.00**
64K Built and tested	**$525.00**
Set of 8X6116P chips (16K)	**$120.00**



Z.A.T. The professional S100 computer at a non professional price!



Don't compromise.With System Z.A.T. you get a machine which can expand in whatever direction your computer needs and interests take you.With full S100 capabilities (7 slots waiting for expansion) you'll never have to spend $500+ on an expansion interface.The super powerful DGZ80 CPU card will take peripherals 'straight on' and the professional VDU card has upper/lower case so you can run all software. This machine is no throwaway toy.Its inherent flexibilty and high standard of performance will make it your wisest investment in micros possible today.

System Z.A.T. with 16K RAM **$1095**

BUY DIRECT & SAVE

How can we offer professional S100 products at such low prices and stay in business? We can do this by keeping overheads low. We only have one outlet. We operate largely by mail order and we design and build our products here in Australia.As a result you get some of the finest S100 products in the world at truly bargain prices.

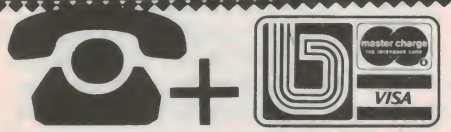
Blue Ribbon
Mail Order Service

Use our Ultra efficient mail order service and find out what Service means.We aim to offer you the fastest delivery possible.And our 10,000 active mail order customers agree we're giving them what they want.Our standard charge is only $2.00 per order to cover package and postage.

Mail orders to
PO Box 311, Hornsby 2077

Interstate?
Needs goods urgently?

Phone order and ask for our $7.50 Overnight Freightbag.We'll rush the goods away tonight.



Order Direct - save time and petrol

Sick of driving across town, only to find a vital IC is out of stock? Do you own a Bankcard? Then let us take the hassle out of it. Just phone (02) 487 2711 give your Bankcard number and order.We'll check stock, price and availability and get the goods on the way.Let us make life a little easier for you.

Goods expected in stock and prices correct at time of going to press.

APPLIED TECHNOLOGY
Showroom/Office at 1A Pattison Ave. Waitara
Hours: 9-5 Monday to Saturday.
Phone: (02) 487 2711 Telex: APPTEC AA72767

Glover & Assoc. AT/10

the current contents if necessary. It contains an automatic address increment facility and may be used to load a program into consecutive memory locations.

This command is also used to *examine* the contents of memory following a program execution or breakpoint. The automatic address increment feature can be used to display the contents of consecutive memory locations.

Command format: **Axxxx<**

xxxx is the hexadecimal address of the memory location for display. Address leading zeros may be omitted.

Following the execution of this command by the entry of the 'carriage return' key (shown thus '<'), the memory address and its contents will be displayed in the following format:

xxxx . . . zz . . . []

zz is the current contents and [] represents the cursor location. To *alter* the memory contents, key in (in hex.) the required data. Leading zeros may be omitted. If no data is entered before a carriage return (CR) or line feed (LF) the contents will remain unaltered.

To *examine* the next memory location (auto address increment) enter a line feed. To exit from this command enter a carriage return.

Set breakpoint: A program *breakpoint* is primarily used during *program fault finding (debugging)* to terminate the execution of a program at a predetermined location. When the breakpoint is encountered, control is returned to the user, who is then able to use the other monitor commands to examine the microprocessor's internal registers or the program's memory locations.

Only one program breakpoint can be set at a time.

Command format: **Bxxxx<**

xxxx is the hexadecimal address of the first byte of the program instruction at which the program 'break' is required. Leading zeros may be omitted.

The breakpoint program operates by altering the contents of the program memory and cannot be used on programs which reside in ROM or EPROM. Two bytes of program data are replaced with '9B'H and the previous data is saved in reserved locations in the monitor's scratchpad RAM memory. When the breakpoint is encountered the original data is returned (auto-clear) to the program and the contents of the microprocessor's internal registers are saved in the monitor's scratchpad RAM.

Clear breakpoint: This command is used to erase a pending program breakpoint. The previous program data is returned and the breakpoint flag reset. If no breakpoint exists the monitor's error message is displayed.

Command format: **C<**

The user should note that the monitor's RAM memory is cleared following a processor reset and any program data stored there due to a pending breakpoint will be lost.

Dump to tape: The *DUMP* command provides the user with a means of saving programs on audio-quality magnetic tape. The SBC monitor outputs binary data at 300 Baud in the same format as the popular BINBUG monitor. This format is approximately six times faster than the original Signetics PIPBUG routine and represents the best compromise of speed and reliability. A suitable frequency shift keyed cassette tape interface must be connected to the serial port on-board.

Command format: **Dssss-ffff-eeee<**

ssss is the start address of the block of data to be saved.

ffff is the finish address of the block of data.

eeee is the optional auto-start program entry address.

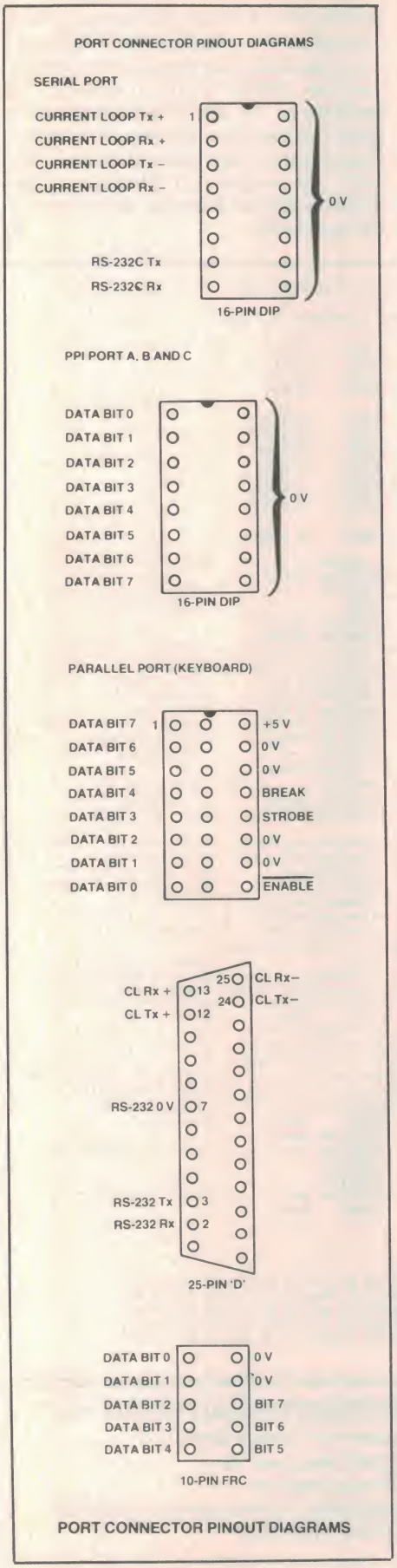
The output format consists of a leader of 32 nulls, a ':' header, a four-byte start address, a two-byte block length, a two-

2650 MEMORY ADDRESS ASSIGNMENT TABLE

Memory Sector (K)	Starting Address	Ending Address
1	0000	03FF
2	0400	07FF
3	0800	0BFF
4	0C00	0FFF
5	1000	13FF
6	1400	17FF
7	1800	1BFF
8	1C00	1FFF
9	2000	23FF
10	2400	27FF
11	2800	2BFF
12	2C00	2FFF
13	3000	33FF
14	3400	37FF
15	3800	3BFF
16	3C00	3FFF
17	4000	43FF
18	4400	47FF
19	4800	4BFF
20	4C00	4FFF
21	5000	53FF
22	5400	57FF
23	5800	5BFF
24	5C00	5FFF
25	6000	63FF
26	6400	67FF
27	6800	6BFF
28	6C00	6FFF
29	7000	73FF
30	7400	77FF
31	7800	7BFF
32	7C00	7FFF

NOTES:

1. Caution should be exercised when attempting program flow across page boundaries (shown thus '----'). Refer to the Signetics 2650 Microprocessor Data Manual.
2. The 2650 Monitor resides in the first 1K sector (0000-03FF) and uses the next 64 bytes of RAM (0400-043F). User RAM commences at 0400.
3. The ETI-640 VDU resides in the 2K address sector 7800-7FFF.
4. The 2650 Disk Operating System (DOS) resides in the 2K address range 6800-6FFF and uses 2K of RAM at 7000-77FF.



byte SOT checksum, the data block and the block checksum. As the data block has a maximum length of 256 characters, the above process is repeated as often as necessary until the end address is reached.

GOTO (and execute): The *GOTO* command instructs the processor to execute the program at a specified hexadecimal address.

Command format: **Gaaaa<**

aaaa is the hexadecimal program execution address. Leading zeros can be omitted.

This command utilises the monitor 'line' subroutine to input a line of up to 20 characters into the 'line buffer'. As only five characters are used by the command, a further 14 characters may be entered (following a delimiting 'space') to pass additional parameters to the executing program.

Load from tape: The *LOAD* command is used to read back a binary data file from tape which has been recorded using the *DUMP* command, or an identical output format. The program extracts the start address from the data file and performs CRC checking. The tape load will be aborted and the monitor's error message displayed if a CRC error is detected.

Command format: **L<**

At the completion of an error-free load the program checks the end of the data file for an auto-start address. If an address is found the program will direct the processor to execute the program at that address. If no address is found the monitor will respond with the '*' prompt message.

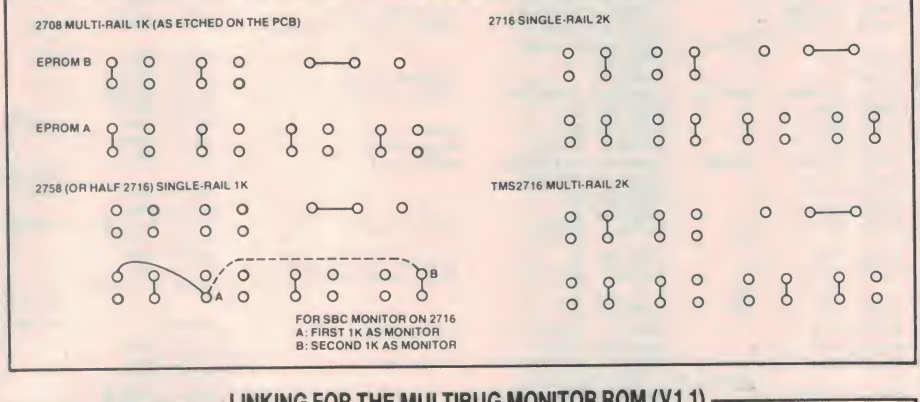
Examine (See and alter) CPU registers: This command is primarily used in conjunction with program breakpoints during program fault finding. Program breakpoints can be used to obtain a 'snapshot' of the program and the microprocessor's status immediately prior to the execution of the instruction at the breakpoint address.

This command is used to display the contents of any of the CPU's seven internal registers and two program status words following the execution of a program breakpoint. It also permits the user to alter the contents of any of these registers and resume program execution using the G command.

Command format: **Sn<**

The number 'n' (valid in the range 0 to 8) is used to select the particular register for display. ▶

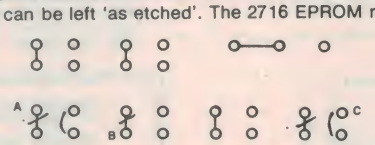
EPROM TYPE SELECTION FIELD (W6)



LINKING FOR THE MULTIBUG MONITOR ROM (V1.1)

The Multibug monitor EPROM is a single +5 V EPROM containing two 1K monitor programs which have been developed for the ETI-685 from the popular BINBUG monitor. This EPROM contains in the first 1K a monitor to interface with 300 Baud serial video terminals and in the second 1K a monitor to interface with S100 buss memory-mapped VDUs (such as the ETI-640). The required monitor program is selected by setting the EPROM's A10 address line to either 0 V (for the serial monitor) or +5 V (for the S100 monitor).

To use the 2716 EPROM the **W6** link field must be rewired from its 'etched' linking, which has been preset for multi-rail 2708 EPROMs. Three links must be broken and the adjacent links closed; all other links can be left 'as etched'. The 2716 EPROM must only be inserted at IC16.



Break the links marked thus

Close the links marked thus

Link A to B for the serial monitor
Link B to C for the S100 monitor

THE S100 MONITOR FOR ETI-640 TYPE VDUs.
The S100 Monitor uses the X5 parallel-in-port connection to interface to a standard parallel keyboard which produces a positive strobe. The port 'enable' line can be tied direct to 0 V and the keyboard should not draw more than 50 mA from the +5 V supply. A 'Break' function using the CPU Sense line can be used if the top half of the W2 link set is rewired (break 1-2 and close 2-3).

0 = register 0
1 = register 1 bank 0
2 = register 2 bank 0
3 = register 3 bank 0
4 = register 1 bank 1
5 = register 2 bank 1
6 = register 3 bank 1
7 = Program Status Word Upper
8 = Program Status Word Lower

The user may alter the displayed register's contents by entering a two-character hexidecimal number before entering a CR or LF. To display the next register (auto increment) enter a LF. To exit from this command, enter a CR.

Follow up

Plans are well advanced to follow up this project with a number of related articles and projects. First up, we have an article coming on the subject of **interfacing**, using the 8255 programmable peripheral interface (PPI). Work is currently in progress on an ASCII keyboard and a cassette interface and we hope to present these as early in the new year as possible, given the vagaries of Murphy's Law, mayhem and the fairies at the bottom of the darkroom . . . ●

```
                ;* MEMORY TEST PROGRAMME
                ;*
                ;* Execute by keying G440_SSSS_EEEE
                ;*
                ;EBUG    EQU     H'001D'
                ;MBUG    EQU     H'0022'
                ;CRLF    EQU     H'0025'
                ;ZOUT    EQU     H'002A'
                ;GAST    EQU     H'00A1'
                ;BOUT    EQU     H'0269'
                ;FOUT    EQU     H'0279'
                ;GNUM    EQU     H'02DB'
                ;*
                ;TEMP    EQU     H'040D'     Start Address pointer
                ;TEMQ    EQU     H'040F'     End Address pointer
                ;*
                ;        ORG     H'0440'
                ;*
0440 0402       ;INIT    LODI,R0 02          Arith. compare
0442 93         ;        LPSL                 Clear Carry, RS1
0443 7640       ;        PPSU    FLAG        Set flag
0445 3F00A1     ;        BSTA,UN GAST        Fetch Start Add.
0448 E504       ;        COMI,R1 04
044A 9805       ;        BCFR,EQ CONT        Not 0400-4FF block
044C 0505       ;        LODI,R1 05          then start at 0500
044E CD040D     ;        STRA,R1 TEMP        Start Add. in TEMP
0451 3F02DB     ;CONT    BSTA,UN GNUM        Fetch End Add.
0454 CD040F     ;        STRA,R1 TEMQ        End Add. in TEMQ
0457 20         ;        EORZ,R0              Hex '00'
0458 CC040E     ;        STRA,R0 TEMP+1      Only 256 byte blocks
045B CC0410     ;        STRA,R0 TEMQ+1
                ;*Print Address block to test
045E BBA5       ;BLOCK   ZBSR    *CRLF       New line
0460 0D040D     ;        LODA,R1 TEMP        High Add. byte
0463 3F0269     ;        BSTA,UN BOUT
0466 0D040E     ;        LODA,R1 TEMP+1      Low Add. byte
0469 3F0279     ;        BSTA,UN FOUT        BOUT with 3 spaces
                ;*Test a 256 byte block
046C 20         ;        EORZ,R0
046D C2         ;        STRZ,R2              Clear index
046E CEE40D     ;WRITE   STRA,R0 *TEMP,R2    Fill block
0471 8401       ;        ADDI,R0 01
0473 8601       ;        ADDI,R2 01          next
0475 9877       ;        BCFR,Z  WRITE       till H'00'
0477 FEE40D     ;READ    COMA,R0 *TEMP,R2    Read back
047A 9826       ;        BCFR,EQ ERROR
047C 8401       ;        ADDI,R0 01
047E 8601       ;        ADDI,R2 01          next
0480 9875       ;        BCFR,Z  READ        till H'00'
                ;*
0482 8401       ;        ADDI,R0 01          Increment for all
0484 986B       ;        BCFR,Z  WRITE       data combinations
                ;*
0486 044F       ;OK      LODI,R0 A'O'
0488 BBAA       ;        ZBSR    *ZOUT       Print 'O'
048A 044B       ;        LODI,R0 A'K'
048C BBAA       ;        ZBSR    *ZOUT       Print 'K'
                ;*Test for End Address
048E 0D040D     ;        LODA,R1 TEMP
0491 ED040F     ;        COMA,R1 TEMQ
0494 1C0022     ;        BCTA,EQ MBUG        End of test
0497 1D001D     ;        BCTA,GT EBUG        Address wrong
049A 8501       ;        ADDI,R1 01          Next block
049C CD040D     ;        STRA,R1 TEMP
049F 1F045E     ;        BCTA,UN BLOCK
                ;*Report error and Address
04A2 C3         ;ERROR   STRZ,R3              Save fail Data byte
04A3 0D040D     ;        LODA,R1 TEMP        High Add. byte
04A6 3F0269     ;IBOUT   BSTA,UN BOUT
04A9 02         ;        LODZ,R2              Low Add. byte
04AA C1         ;        STRZ,R1
04AB 3F0279     ;        BSTA,UN FOUT
04AE 03         ;        LODZ,R3              Print fail data byte
04AF C1         ;        STRZ,R1
04B0 3BF5       ;        BSTR,UN *IBOUT+1
04B2 9B22       ;        ZBRR    MBUG        Abort test.
                ;*
00 ERRORS DETECTED

0440 04 02 93 76 40 3F 00 A1 E5 04 98 05 05 05 CD 04
0450 0D 3F 02 DB CD 04 0F 20 CC 04 0E CC 04 10 BB A5
0460 0D 04 0D 3F 02 69 0D 04 0E 3F 02 79 20 C2 CE E4
0470 0D 84 01 86 01 98 77 EE E4 0D 98 26 84 01 86 01
0480 98 75 84 01 98 68 04 4F BB AA 04 4B BB AA 0D 04
0490 0D ED 04 0F 1C 00 22 1D 00 1D 85 01 CD 04 0D 1F
04A0 04 5E C3 0D 04 0D 3F 02 69 02 C1 3F 02 79 03 C1
04B0 3B F5 9B 22
```

```
                ;* 8255 PPI TEST PROGRAMME
                ;*
                ;*Execute by entering 'G500'
                ;*
                ;PORTA   EQU     H'00'
                ;PORTB   EQU     H'01'
                ;PORTC   EQU     H'02'
                ;CNTRL   EQU     H'03'
                ;*
                ;EBUG    EQU     H'001D'
                ;MBUG    EQU     H'0022'
                ;ZOUT    EQU     H'002A'
                ;BOUT    EQU     H'0269'
                ;FORM    EQU     H'027B'
                ;FOUT    EQU     H'0279'
                ;COUT    EQU     H'02B4'
                ;*
                ;        ORG     H'0500'
                ;*
0500 0480       ;INIT    LODI,R0 H'80'       All port output
0502 D403       ;        WRTE,R0 CNTRL
0504 20         ;        EORZ,R0              Arith. compare, clear
0505 93         ;        LPSL                 carry and RS1.
0506 C809       ;        STRR,R0 WRITE+1
0508 C809       ;        STRR,R0 READ+1
                ;*Test port by writing a bit pattern and then
                ;*       read it back and compare
050A 0600       ;START   LODI,R2 H'00'       Loop counter
050C 0708       ;TEST    LODI,R3 H'08'       Byte counter
050E 0580       ;        LODI,R1 H'80'       Bit 8 set
0510 D500       ;WRITE   WRTE,R1 PORTA       Output data pattern
0512 5400       ;READ    REDE,R0 PORTA       Read data back
0514 E1         ;        COMZ,R1              then compare
0515 9829       ;        BCFR,EQ ERROR
0517 51         ;        RRR,R1               Shift set bit
0518 FB76       ;        BDRR,R3 WRITE       eight times then
051A FA70       ;        BDRR,R2 TEST        loop 256 times
                ;*
051C 0973       ;        LODR,R1 WRITE+1     Fetch current port
051E F501       ;        COMI,R1 PORTC-1     At port C yet
0520 1D052B     ;        BCTA,GT END         Yes, all ports OK
0523 8501       ;        ADDI,R1 01          No, next port number
0525 C96A       ;        STRR,R1 WRITE+1      loaded
0527 C96A       ;        STRR,R1 READ+1
0529 1B5F       ;        BCTR,UN START       Continue test
                ;*Print the PPI OK message
052B 7600       ;END     PPSU                FLAG
052D 0700       ;        LODI,R3 0           Init. loop cntr.
052F 0F2538     ;PRINT   LODA,R0 TEXT-1,R3+  Fetch byte
0532 1C0022     ;        BCTA,Z  MBUG        Last byte is zero
0535 BBAA       ;        ZBSR    *ZOUT       Print byte
0537 1B76       ;        BCTR,UN PRINT       Loop
0539 50504920   ;TEXT    DATA A'PPI OK',0
                ;*Print the error message
0540 C2         ;ERROR   STRZ,R2             Save found value in R2
0541 0848       ;        LODR,R0 START+1     Fetch port value
0543 8441       ;        ADDI,R0 H'41'       Convert to Alpha
0545 BBAA       ;        ZBSR    *ZOUT       Print port
0547 3F027B     ;        BSTA,UN FORM
054A 3F0279     ;        BSTA,UN FOUT        Print written value
054D 02         ;        LODZ,R2
054E C1         ;        STRZ,R1
054F 3F0269     ;        BSTA,UN BOUT        Print found value
0552 9B1D       ;        ZBRR    EBUG
                ;*
00 ERRORS DETECTED

0500 04 80 D4 03 20 93 C8 09 C8 09 06 00 07 08 05 80
0510 D5 00 54 00 E1 98 29 51 FB 76 FA 70 09 73 E5 01
0520 1D 05 2B 85 01 C9 6A C9 6A 1B 5F 76 00 07 00 0F
0530 25 38 1C 00 22 BB AA 1B 76 50 50 49 20 4F 4B 00
0540 C2 08 48 84 41 BB AA 3F 02 7B 3F 02 79 02 C1 3F
0550 02 69 9B 1D
```

OTHER RELATED ETI PROJECTS THAT MAY INTEREST YOU

ETI-635 Microcomputer Power Supply **Sept. '77**
ETI-640 S100 VDU **April, May, June '78**
ETI-636 S100 Motherboard **May '80**
ETI-681 S100 Programmable Character Generator **June '80**
ETI-682 S100 PROM Board **March '81**

Electronics Today International is published by Murray Publishers Pty Ltd, 15 Boundary St, Rushcutters Bay NSW 2011. It is printed (in 1981) by Offset Alpine, cnr. Wetherill and Derby Sts, Silverwater NSW, and distributed by Gordon and Gotch.

Mail enquiries: There is no charge for replies, but a foolscap-sized, stamped, addressed envelope must be enclosed. Queries relating to projects can only be answered if related to the item as published. We cannot advise on modifications to projects, other than errata or addenda, nor if a project has been modified or if components are other than specified. We try to answer letters as soon as possible. Difficult questions may take time to answer.

Phone enquiries: We can only answer readers' technical enquiries by telephone after 4.30 pm. In enquiring by telephone about back issues or photostats, please ask for the Subscriptions Department.

(02)33-4282

Editorial and Sales Office:
4th Floor, 15 Boundary St, Rushcutters Bay NSW 2011. Ph. 33-4282; Tlx: 27243
Sales Manager: **Bob Taylor**
Sales Admin: **Pam Lord**
(address as above)

Melbourne: Virginia Salmon, 150 Lonsdale St, Melbourne Vic 3000. Ph: 662-1222; Tlx AA34543.

Adelaide: Admedia Group, 24 Kensington Rd, Rose Park SA 5067. Ph: 332-8144; Tlx AA82182.

Brisbane: Geoff Horne Agencies, 16 Bellbowrie Centre, Bellbowrie Qld 4070. Ph: 202-6813.

Perth: Aubrey Barker, 133 St Georges Terrace, Perth WA 6000. Ph: 322-3184; Tlx: AA93810

New Zealand: Frank Hargreaves, Circulation Marketing Manager, c/- ACP, 4th Floor, Sun Alliance House, 42-44 Shortland St, Auckland. Ph: (9)30311.

United Kingdom: Australian Consolidated Press, Ludgate House, 107 Fleet St, London EC4A 2AL. Ph: 353-1040; Tlx: 267163.

Japan: Genzo Uchida, Bancho Media Services, 15 Sanyeicho, Shin juku-Ku, Tokyo 160. Ph: 359-8866; Cable: Elbanchorito; Tlx: BMSINC J25472 Tokyo.

USA: Australian Consolidated Press, 21 East 40th Street (Floor 23), New York NY 10016. Phone: (212) 685-9570.

ORDER FORM

I enclose $ ..... for (tick appropriate box/es). All prices include postage.
Send orders to: ETI, 4th Floor, 15 Boundary St, Rushcutters Bay NSW 2011. Phone: (02)33-4282.

☐ **Subscriptions** $23.30 per year within Australia $.....
$36.60 overseas (surface mail) $.....
Airmail rates on application

☐ **Back issues** $2.50, available from November 1978.

☐ **or photocopies** $2.50 per article per issue
Project No. ..... Month ..... Year ..... $.....
Project No. ..... Month ..... Year ..... $.....
Project No. ..... Month ..... Year ..... $.....
Project No. ..... Month ..... Year ..... $.....
Please attach a list if more than four required.

☐ **Binders** No. ..... @ $6.10 in NSW $.....
No. ..... @ $7.50 in other states $.....

NAME (Please print)

.....

ADDRESS .....

.....

.....

.....

.....

..... **POSTCODE** .....

DON'T FORGET TO CHECK WITH US BEFORE YOU BUY A COMPUTER OR OTHER PRODUCTS

ROD IRVING ELECTRONICS

425 HIGH STREET, NORTHCOTE 3070. MELBOURNE. VICTORIA.

S100 COMPUTER PRODUCTS

16K EPROM CARD-S 100 BUSS

$89.50 KIT

BLANK PC BOARD $49

USES 2708's!

Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450 NS 2708'S ARE $5.90EA. WITH PURCHASE OF KIT

ASSEMBLED AND FULLY TESTED ADD $36

32K S-100 EPROM CARD

NEW!

$99.95

KIT

USES 2716's

Blank PC Board – $59

ASSEMBLED & TESTED ADD $30

SPECIAL: 2716 EPROM's (450 NS) Are $5.90 EA. With Above Kit.

KIT FEATURES

1. Uses +5V only 2716 (2Kx8) EPROM's
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible
4. Addressable as two independent 16K blocks
5. Cromemco extended or Northstar bank select
6. On board wait state circuitry if needed
7. Any or all EPROM locations can be disabled
8. Double sided PC board, solder-masked, silk-screened
9. Gold plated contact fingers
10. Unselected EPROMs automatically powered down for low power
11. Fully buffered and bypassed
12. Easy and quick to assemble

* * * AVAILABLE AGAIN * * *

- 16K Dynamic Ram Board
- Fully Expandable to 64K
- Assembled, tested and guaranteed
- S100 Compatible

16K Dynamic RAM Board assembled and tested Special $269 plus tax (4mHz) $299 plus tax (4mHz) This must be the best offer available on quality tested dynamic RAM boards.

32K Assembled and tested $289 plus tax (4mHz)

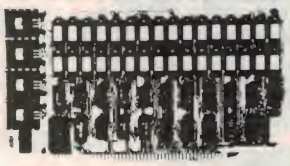
48K Assembled and tested $309 plus tax (4mHz)

64K Assembled and tested $329 plus tax (4mHz)

16K STATIC RAM KIT-S 100 BUSS

KIT $189

A&T $219



KIT FEATURES

1. Addressable as four separate 4K Blocks
2. ON BOARD BANK SELECT circuitry (Cromemco Standard) Allows up to 512K on line
3. Uses 2114 (450NS) 4K Static Rams
4. ON BOARD SELECTABLE WAIT STATES
5. Double sided PC Board with solder mask and silk screened layout Gold plated contact fingers
6. All address and data lines fully buffered
7. Kit includes ALL parts and sockets
8. PHANTOM is jumpered to PIN 67
9. LOW POWER under 1.5 amps TYPICAL from the +8 Volt Buss
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W DATA $55

LOW PROFILE SOCKET SET $22

SUPPORT IC'S & CAPS $29

ASSEMBLED & TESTED ADD $30

OUR #1 SELLING RAM BOARD!

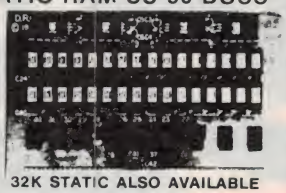
16K STATIC RAM SS-50 BUSS

PRICE CUT!

$199 KIT

A&T $219

FULLY STATIC AT DYNAMIC PRICES



32K STATIC ALSO AVAILABLE

KIT FEATURES

1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Runs at Full Speed
4. Double sided PC Board Solder mask and silk screened layout Gold fingers
5. All Parts and Sockets included
6. Low Power Under 1.5 Amps Typical

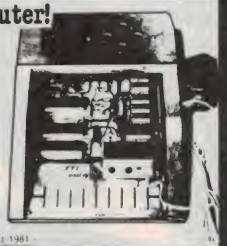
FOR SWTPC 6800 BUSS!

BLANK PC BOARD – $49 COMPLETE SOCKET SET – $22 SUPPORT IC'S AND CAPS – $45

NOW A $99 Computer!

Plugs into any TV!

ETI 660



No one would have believed it a few years ago. Features include colour capability, operates from optional 9V plugpack, 1K memory expandable to 3K on-board, single board construction, cassette interface, audio output (play tunes), simple to program (uses Chip-8). Expansion projects coming up include: ASCII keyboard, light pen, games software etc. (So we are told)

Starter Kit (1K RAM, B&W video)	$99.00
9V 200mA plugpack to suit	$6.50
Colour video option	$8.00
RAM EXPANSION (add to PCB)	$16.00

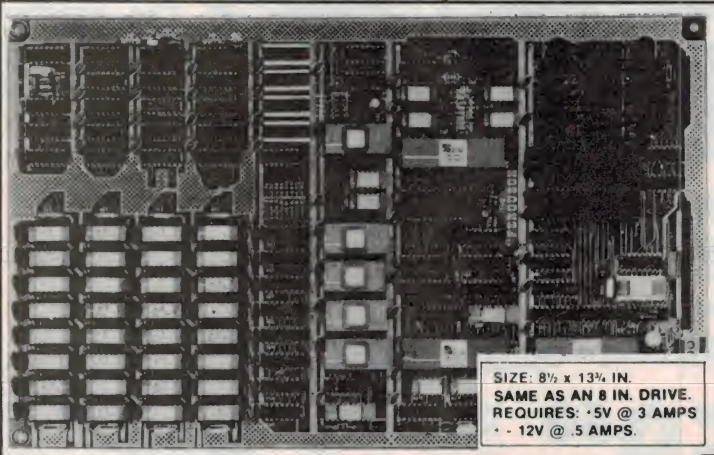
As with all new kits, please phone first to check stocks. We expect the kit to be in stock some time in Oct 1981

ETI636 7 SLOT MOTHERBOARD WITH ACTIVE TERMINATION

Kit of Parts $89.00. Assembled and tested $115.00, inc tax

RITRON COMPUTER GRADE POWER SUPPLY: +5V Reg, 10A, ± 16V Unreg. Kit of parts $89.90 inc tax A&T $109.00 inc tax

Write for list of other power supplies. Tax free prices also available.



SIZE: 8½ x 13¾ IN.
SAME AS AN 8 IN. DRIVE.
REQUIRES: +5V @ 3 AMPS
+ - 12V @ .5 AMPS.

SINGLE BOARD COMPUTER KIT NOW ONLY $649 + TAX (17½%)

Also available,

Blank PCB's with Roms $295 + Tax.

THE FERGUSON PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, and an enclosure, and you have a total Business System for about 1/3 the cost you might expect to pay.

FEATURES: (Remember, all this on one board!)

64K RAM

Uses industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERUPTS. Fully buffered and runs 8080 software.

24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true.

SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: $95

FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2.

BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

FOUR PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O: $45

REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: $25

PFM 3.0 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided. It does not occupy any of the 64K of system RAM!

Bankcard Mail Orders Welcome

Please debit my Bankcard

Bankcard No._____

Expiry Date_____

Name_____

Signature_____

General enquiries (03) 489-8131. Mail order enquiries (03) 481-1436. Ritronics Wholesale (03) 489-7099. (Tax Exempt Enquiries)

Prices subject to change without notice. Send 60¢ and SAE for free Price lists. MAIL ORDERS PO BOX 235, NORTHCOTE, Vic. 3070. Minimum pack and post $5.00. Telex AA38897.

PLEASE WRITE OR RING FOR THE BEST POSSIBLE PRICES ON DISC DRIVES, PRINTERS AND OTHER COMPUTER COMPONENTS.

Limited Quantity – Be Quick

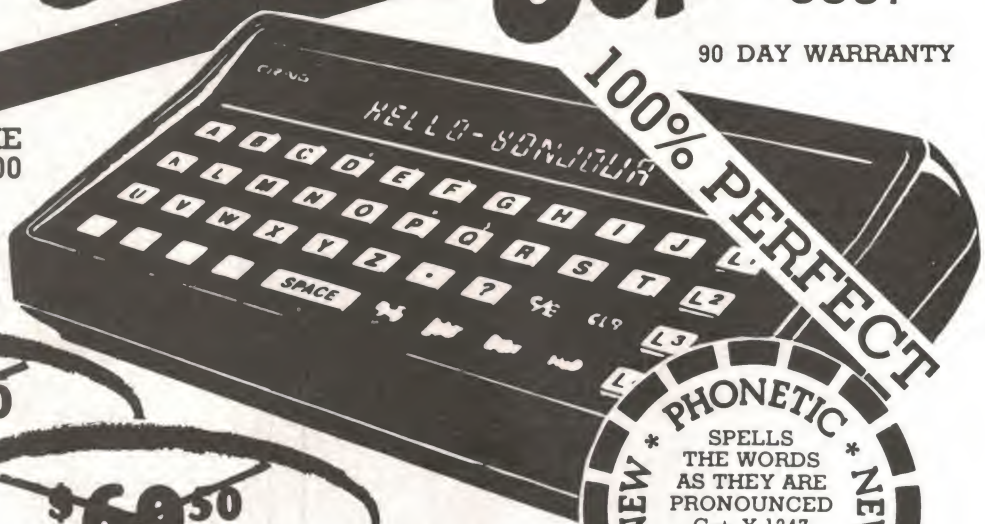
AMAZING BOO-BOO

A manufacturer's mistake means we can sacrifice these incredible CRAIG language translators at a staggering

OVER 80% OFF!

WAY BELOW COST

90 DAY WARRANTY



THE CRAIG M100

This unit sold in Australia for $250 and over 200,000 were sold world wide at similar prices. The manufacturer made too many and we have scooped a limited quantity at WAY BELOW the manufacturer's cost!

~~$250.00~~

~~$69.50~~

$59.50 Includes English Cartridge

Cat. Y-1340

NEW * PHONETIC * NEW * CARTRIDGE *

SPELLS THE WORDS AS THEY ARE PRONOUNCED

Cat. Y-1347

$9.50

How would YOU like to be able to convey your thoughts, needs and questions in another language? Well now you can! The CRAIG M100 enables you to type in a message and at the touch of a button translate that message into another language. It even has whole phrases that can be called up at the touch of a button and partial phrases to which you can add your own ending. A truly remarkable unit that can calculate (e.g. currency conversions) and it has inbuilt metric conversions, a great boon! The Craig M100, a true hand-held language computer with RAM, ROM and CPU! Ideal for businessmen on overseas trips, students studying languages etc.

It is recommended that you use 4 Duracells (Cat. S-3280) at $1.60 or 4 Nicads (Cat. S-3300) at $2.25 each. If using the Nicads they can be re-charged in the Craig M100 by using the M-9525 battery eliminator which also serves to power the unit from the AC. The M-9525 is great value at $9.75.

LANGUAGE CARTRIDGES

Japanese (Y-1342)	$14.50
German (Y-1343)	$16.50
Italian (Y-1344)	$14.50
Bar & Wine Guide (Y-1345)	$10.00
Calorie Counter (Y-1346)	$9.50
Spanish (Y-1348)	$16.50

SAVE up to 60%

Normally $35 ea.

7 DAY SATISFACTION GUARANTEE
TRY ONE AND SEE!

If you are not totally satisfied return the unit in the same condition as received and your money will be refunded.

DICK SMITH ELECTRONICS

SEE OUR OTHER ADS FOR A FULL LIST OF STORE ADDRESSES

DSE/939/RB

Sorcerer Competition

We are running a programming competition and encourage anyone with time and enthusiasm to enter. Prizes will total over $2,500.00! One prize of $500.00 will be awarded to each winning entry in all 5 sections with the chance of more than one winning entry per section if the standard is particularly high.

SECTION 1: Games – Any type of game will be accepted although we recommend the arcade styles such as Asteroids or Adventure games.

SECTION 2: Utilities – Here a wide range of options is available including Graphics, Plotting, Assemblers, Mini Compilers, Printer Drivers and Disk Utilities.

SECTION 3: Educational – Anything from child education in Maths and Spelling to computing such as the Machine Code tutorials.

SECTION 4: Serious Applications – This may include Data Base programs, Accounting Systems (both cassette and disk based), Maths and Scientific packages, Astronomy and other special purpose applications.

SECTION 5: Miscellaneous – Anything not covered above such as Novelty Programs, Hardware/ Software combinations, Sound Generation and Wordprocessor programs would come under this section.

CONDITIONS OF ENTRY

All applications must be lodged at System Software on or before the 31st December, 1981.

Entries should be submitted on cassette at both 1200 and 300 baud twice each. If the software is to be run on disk, instructions should be included on uploading.

No entry will be returned unless specifically requested and return postage forwarded.

Entries will be judged according to: (1) Programming technique. (2) Reliability. (3) Usefulness. (4) Creativity. (5) Originality. (6) Marketability and (7) Documentation.

At least one (1) winning entry will be taken from each section.

The Judges' decisions will be final and no correspondence will be entered into.

A prize of $500.00 will be awarded to each winning entry.

Only winning entries will become the property of System Software.

The names of all programmers submitting winning entries will be published in a subsequent catalogue unless otherwise requested.

SYSTEM SOFTWARE
1 KENT STREET, BICTON
WESTERN AUSTRALIA 6157
TELEPHONE: ISD (619) STD (09) 339 3842
Sunday through to Friday.
Ask for Richard Swannell for personal service.

SUPER ASTEROIDS by Apollo

'A new era in real time graphic arcade games'.

Never has there been such a captivating and superbly written arcade game for the Sorcerer. Styled after the well known and very popular ASTEROID DELUXE arcade game, SUPER ASTEROIDS is destined to become the most popular piece of demonstration software used by dealers and users alike. Perhaps it is the outstanding use of fine line graphics or the silky smooth movement. Maybe it is the breathtaking speed, dazzling explosions, gripping sound effects or simply the challenge of avoiding those fire balls from that persistent flying saucer that insidiously follows you across the screen. Whatever it is, we warn you NOT to purchase this game for fear that you may join the ranks of hundreds of other ASTEROID Addicts who, square and bleary eyed at 3 am, just MUST have ONE more go at trying to beat that High Score.

The object is to guide a small space ship across the screen avoiding but shooting asteroids as they glide past. When an asteroid is hit, it will break up into many smaller pieces. By repeatedly hitting the pieces they will soon disintergrate and disappear. If you crash your ship into an asteroid it will break into pieces and splinter across the screen in a shower of sparks! However, if you manage to stay in one piece, chances are you'll soon be pursued by a flying saucer that shoots balls of fire! Best that you treat him with care, else you may make his friends VERY aggressive.

Apollo has used a novel but ingenius method of continually reprogramming graphics characters and has obtained stunning results! All movement is done pixel by pixel but without speed loss. Numbers of asteroids, directions, speeds and such like are all totally unpredictable. If you can show us a piece of software that has finer, smoother and faster graphics than SUPER ASTEROIDS, we guarantee to refund your money in full!

Cassette $29.95

ZAP80 by Ian Robinson

'Secret Code Disassembler'

This is far from your average run-of-the-mill disassembler! Other than being a mere 4K long, able to disassemble at the speed of light and packed with options, ZAP80 will display before your very eyes all those unknown instructions ZILOG never talk about! Ian has been doing extensive research into the actions of the Z80 processor when confronted with the 700 or so undocumented (and so called 'illegal') code sequences. Over 100 of these are VERY useful! Did you know you have extra 8 bit registers and a complete set of instructions to manipulate them? Did you know about extra rotate instructions?

ZAP80 will disassemble ANY code sequence. Nothing is illegal! It will allow you to program with codes that no other disassembler can decipher! Think about that ....

ZAP80 comes with documentation and explanation of all new mnemonics used. Three versions are supplied that reside in low, mid and high memory. Options include ASCII output, screen pause and customised printer control.

Whether you are a serious programmer, a beginner or simply curious, ZAP80 is a piece of software you must have. Come and play a REAL adventure game!

Cassette $24.95

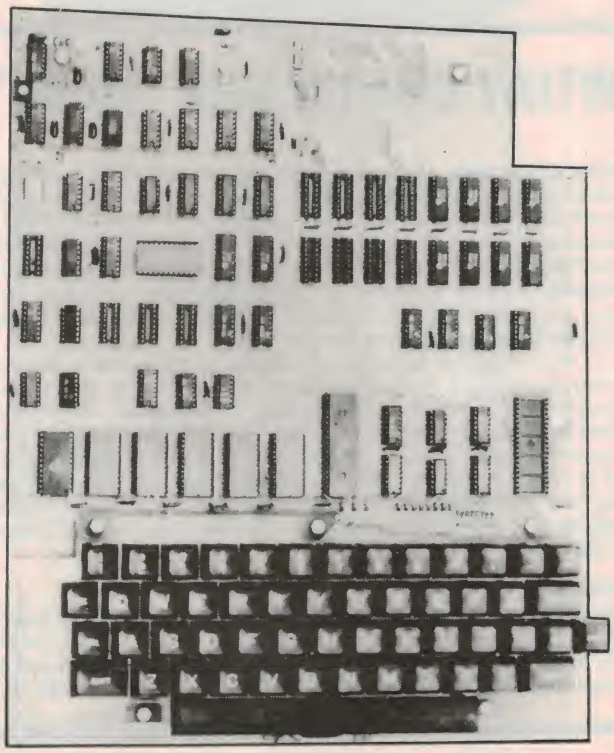
Postage within Australia is $1 for initial item and 50c for each additional. Outside Australia is $2 and 50c.

You'll have to believe this!

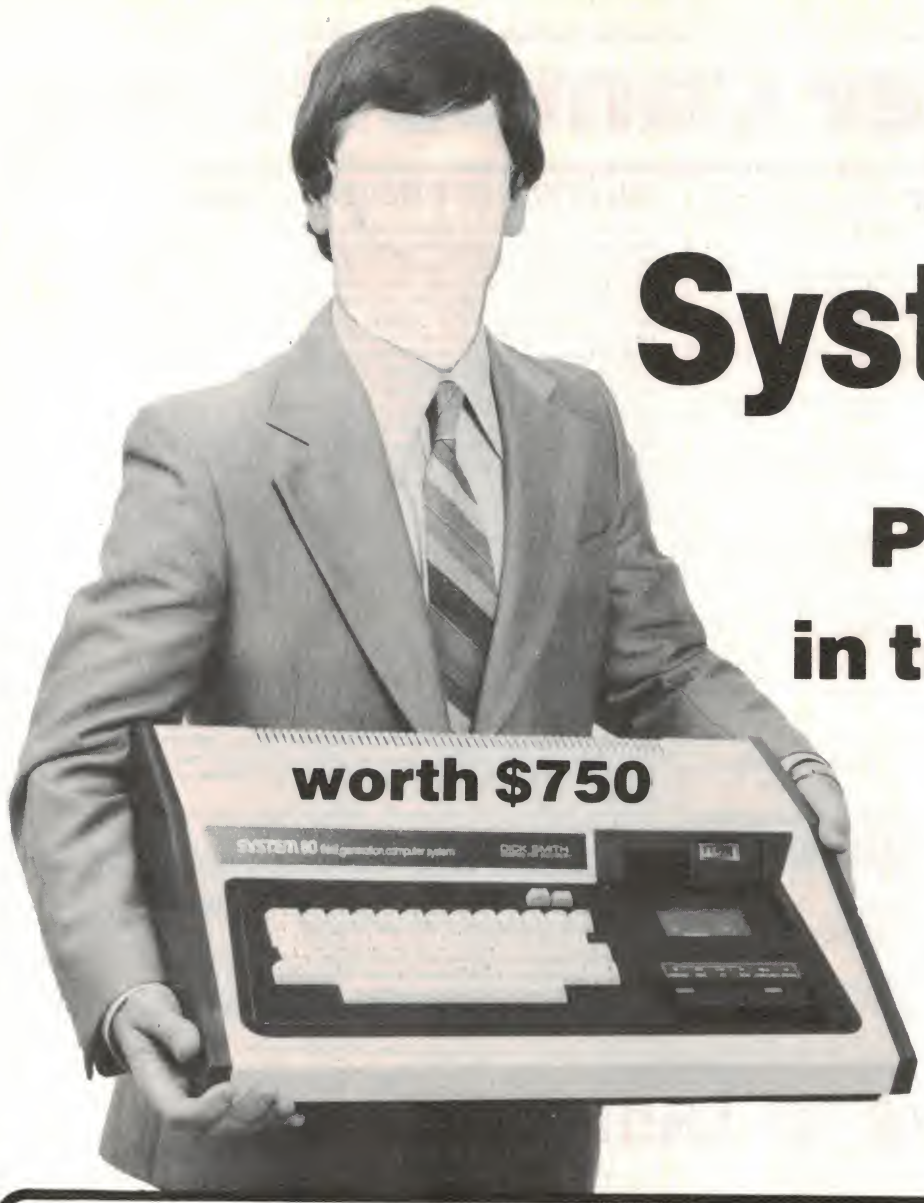
$156 SAVING
ON THE OHIO SCIENTIFIC
SUPERBOARD II

You get:

- a fully assembled unit
- 8 K Microsoft BASIC in ROM
- 24 x 24 or 12 x 48 display
- 4 K RAM
- Graphics are standard
- Full keyboard
- Video interface
- Cassette interface
- Printer port standard



All this for $319
PLUS SALES TAX
TCG OHIO SCIENTIFIC PTY. LTD.
31-33 HUME ST., CROWS NEST
N.S.W. 2065
TEL. 439 3930



A Dick System 80

Put yourself in the picture!

Enter this contest and you too could use this computer featuring the most popular microprocessor IC – the Z80. The door to the world of microcomputing could open for you. Just load the crossword with your data (sorry, we've no level meter like the System 80), write an essay and send us the coupon (or a copy plus the bottom corner of the page).

WHAT COULD YOU DO WITH A PERSONAL COMPUTER?

More to the point, what could you do with Dick Smith's System 80 personal computer? Thousands of purchasers seem to have found plenty of applications. Dick Smith Electronics claim the System 80 is Australia's fastest selling computer in its field. It's quite a powerful machine, having 16K of user RAM and offering a full 12K version of the industry-standard Microsoft BASIC programming language. The microprocessor employed is the powerful Z80 — the most popular 8-bit microprocessor chip in the world.

A whole range of software is available for use on the System 80, which incidentally is compatible with almost all TRS-80 software, according to Dick Smith. You can play fun games like 'Poker Pete', 'Rescue at Rigel' (a space adventure game), 'Flight Simulator' (pilot your own plane), 'Interlude' (spice up your love life!), 'Super Maze' and of course the one and only 'Space Invaders'. A System 80 can become a learning tool with software such as 'Typing Tutor', 'Speed Reading Course', 'Learn Music', etc. You can turn a System 80 into a small business computer too.

WHAT'S IT GOT?

The System 80 features a built-in cassette, a built-in power supply, S100 buss expansion capability, RF output (you can connect it to any TV set), two motor-controlled cassette interfaces (you can add an extra cassette), memory expansion to 48K (total) possible, 12K Microsoft BASIC in ROM, 16K of RAM on-board and software compatible with most level II Tandy software.

THE CONTEST

Last year, in conjunction with Dick Smith Electronics, we ran a contest with a System 80 as a prize. It attracted an extraordinarily high level of entries and was one of the most successful contests we had ever run. Once again, Dick Smith has offered a System 80 as a prize for a contest. This time all you have to do is correctly complete the simple crossword and tell us in a short essay what you would do with a System 80.

Here's your chance to win a Dick Smith System 80, worth $750, for nothing!

This contest is jointly sponsored by ETI Magazine and Dick Smith Electronics — who have generously donated the prize.

You may enter as many times as you wish but you must use a separate entry form for each entry and include the month and page number cut from the bottom right hand page of the contest. You must put your name and address where indicated on each entry form and sign and date each.

NOTE: Please read contest rules carefully, especially if sending in multiple entries.

Smith to win!

RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of Dick Smith Electronics, Murray Publishers Pty Ltd, Australian Consolidated Press, Offset Alpine Pty Ltd, or associated companies.

Entries should be addressed to ETI System-80 Contest, Electronics Today International, 15 Boundary St, Rushcutters Bay NSW 2011.

Closing date for the contest is January 31 1982. Entries received within seven days of that date will be accepted if postmarked prior to and including January 31 1982.

The contest will be judged by the Managing Editor of ETI, whose decision will be final. No correspondence can be entered into regarding his decision.

The winner will be advised by telegram the same day the result is declared. The name of the winner, together with the winning answers, will be published in the next possible issue of ETI.

Contestants must enter their names and addresses where indicated on each entry form. Photostats or clearly written copies will be accepted, but if sending copies you must cut out and include with each entry the month and page number from the bottom of the right hand page of the contest. In other words you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in states where local laws prohibit entries.

Entrants must sign the declaration accompanying this contest that they have read the above rules and agree to abide by their conditions.

YOU'LL FIND THE CROSSWORD ANSWERS ON THESE PAGES!

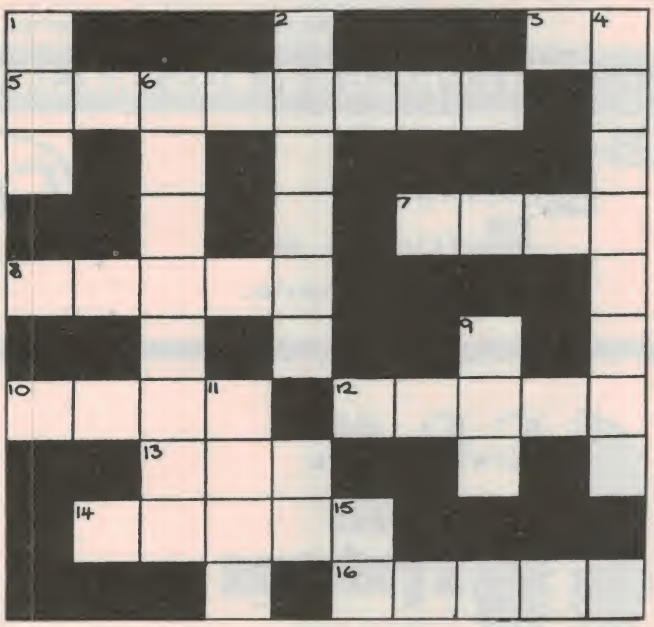
CROSSWORD CLUES

ACROSS

3. I see, it's got great capabilities.
5. There's something about my Tess that was a good seller last year.
7. The fish is alone on the old block.
8. Teren! Come in and turn around.
10. Hello, add this to your computer.
12. This shop keeps information.
13. I program my sheep to remember in the end.
14. Measure it. Electronically, not with a rule.
16. This type of pasture can be filed away.

DOWN

1. Us? That's not complete to be put to a purpose.
2. I recall everything about my Rome.
4. The Commanding Officer and 1000 put errors together to operate efficiently.
6. Cassettes are soft. Warehouses should be loaded.
9. Caesar's capital loses in the end.
11. Ted, at a keyboard, has information.
15. Robert Fulton initially creates interference.



TO ENTER, JUST COMPLETE THE CROSSWORD AND WRITE US A SHORT ESSAY

Tell us, in 50 words or less, how you would use a System 80 personal computer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Name .....

Address .....

.....

.....

..... Postcode .....

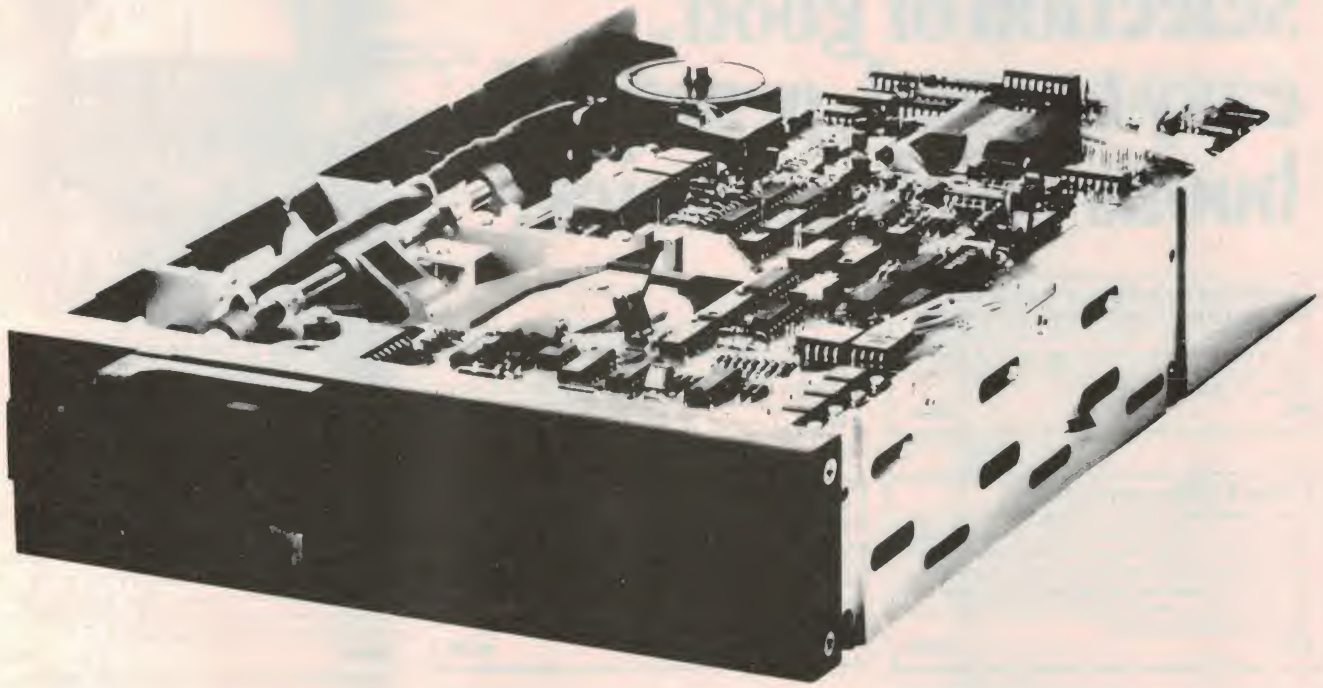
I have read the Contest Rules and agree to abide by their conditions.

Signed .....

Date .....

Don't forget to fill out the coupon.
Contest closes 31 January 1982.

TANDON
NEW EIGHT-INCH
THINLINE DISK DRIVES



Tandon CORPORATION

Tandon Corporation's new high performance, eight-inch THINLINE flexible disk drives offer single- and double-sided, double density, 48 TPI. The memory capacity of word processors, small business systems, and intelligent terminals can be doubled by installing two drives in the existing cabinet space currently required by only one drive. Exceptional features are:

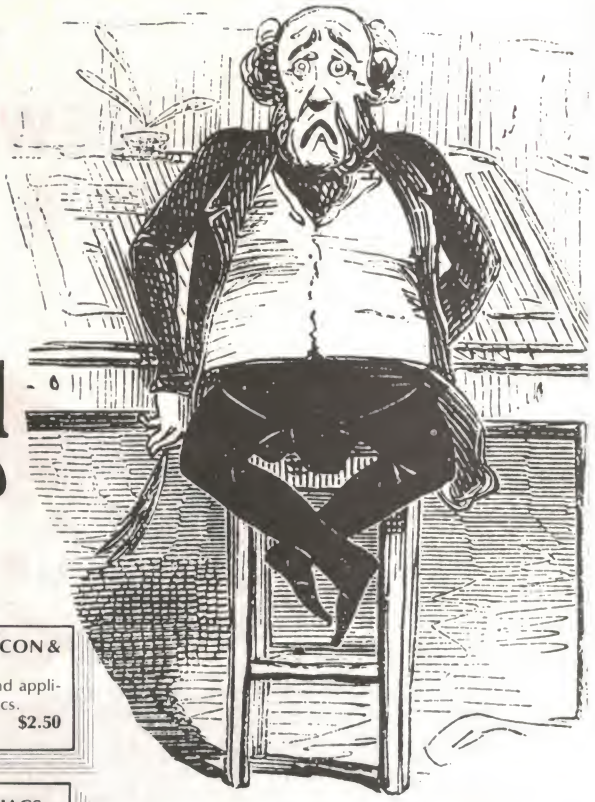
- Exactly one-half the height of any other model.
- Proprietary, high-resolution, read-write heads patented by Tandon.
- D.C. only operation – no A.C. required.
- Industry standard interface.
- Three millisecond track-to-track access time.

ADAPTIVE ELECTRONICS ARE THE SOLE AUSTRALIAN DISTRIBUTORS
Immediate Delivery – Boxes and Power Supplies also available.
For Further Information contact MARTIN COLLETT on (03) 267 6800
Dealer Enquiries Welcome.

AE ADAPTIVE ELECTRONICS P/L

418 ST.KILDA ROAD, MELBOURNE, VICTORIA, AUSTRALIA, 3004.
TELEPHONE: (03) 267-6800 TELEX: AA32565

Where do you get a comprehensive selection of good, easy-to-read, practical books on electronics?



HANDBOOK OF RADIO, TV, INDUSTRIAL & TRANSMITTING TUBE & VALVE EQUIVALENTS
Equivalents book for amateurs and servicemen. More than 18 000 old and new valves from UK, USA, Europe, Japan et al. CV (military) listings with commercial equivalents included.
BP2 **$2.25**

COLOUR CODE & DATA CHART
A very useful wall chart containing resistor and capacitor colour codes and how to read them, audio connector colour codes, transformer wires colour codes, battery cord colour codes, PLUS - charts and formulae for resistors, capacitors and inductors in parallel and series; resistor power ratings chart, 50/75 ohm attenuator tables and more ...
BP7 **$1.50**

FIRST BOOK OF PRACTICAL ELECTRONIC PROJECTS
Full constructional data, circuits, components lists for many practical projects including audio distortion meter, super FET receiver, guitar amp, metronome, etc.
BP23 **$2.55**

52 PROJECTS USING IC 741
A must for those interested in any way in this inexpensive and versatile IC. European best seller!
BP24 **$3.20**

GIANT CHART — RADIO, ELECTRONICS, SEMI-CONDUCTOR & LOGIC SYMBOLS
Identify those symbols at a glance. A must for beginners and advanced enthusiasts alike. Professionals can always hide it in their desks! A steal at only ...
BP27 **$2.20**

ELECTRONIC CALCULATOR USERS' HANDBOOK
Invaluable for all calculator users. Presents formulae, data, methods of calculation, conversion factors etc, often with examples. Includes way to use simple calculator for trig functions (sin, cos, tan); hyperbolic functions (sinh, cosh, tanh); logs; square roots; and powers.
BP33 **$4.20**

50 CIRCUITS USING GERMANIUM, SILICON & ZENER DIODES
Contains 50 interesting and useful circuits and applications in many different branches of electronics.
BP36 **$2.50**

50 PROJECTS USING RELAYS, SCRs & TRIACS
Relays, SCRs and Triacs are used in motor speed control, dimming, heating, timers, light sensitive devices, warning circuits, light modulators, priority indicators, circuit breakers etc. Book gives tried and proven circuits allowing easy modification to suit special needs.
BP37 **$4.20**

FUN AND GAMES WITH YOUR CALCULATOR
Amazing collection of 101 jokes and riddles, several quite mind-boggling games for two or more players and a dictionary of numbers which are words if the calc. is read upside down.
BP38 **$2.50**

DIGITAL ICs & PIN CONNECTIONS
Equivalents and pin connections of popular user-orientated digital ICs. Details of packaging, families, functions, manufacturer, and countries of origin. Includes Fairchild, Ferranti, Harris, ITT, Motorola, National, Philips, RCA, Signetics, Sescocem, SGS-Ates, Siemens, SSSI, Stewart Warner, AEG-Telefunken, Texas, Teledyne. Companion volume to BP41.
BP40 **$8.45**

LINEAR IC EQUIVALENTS & PIN CONNECTIONS
Similar to BP 40 but deals with linear ICs.
BP41 **$9.25**

50 SIMPLE LED CIRCUITS
50 interesting and useful circuits and applications using LEDs. A useful book for beginner and advanced enthusiast alike.
BP 42 **$3.20**

HOW TO MAKE WALKIE-TALKIES
Practical circuitry and construction of transmitters, receivers and antennas. A book of great interest to the licensed operator especially. This book was written with the UK licensing regulations in mind. Some parts may not accord with local regulations.
BP43 **$5.10**

MOBILE DISCO HANDBOOK
Most people who start mobile discos know little about equipment or what to buy. This book assumes no preliminary knowledge and gives enough info to enable you to have a reasonable understanding of disco gear.
BP 47 **$4.55**

ELECTRONIC PROJECTS FOR BEGINNERS
This book gives the newcomer to electronics a wide range of easily built projects. Actual components and wiring layouts aid the beginner. Some of the projects may be built without using soldering techniques.
BP 48 **$4.55**

POPULAR ELECTRONIC PROJECTS
A collection of the most popular types of circuits and projects covering radio, audio, household and test equipment.
BP 49 **$4.90**

REACTANCE/FREQUENCY CHART FOR AUDIO AND RF.
Enables the reactance of any capacitor or resistor to be read off immediately — from 10 Hz to 100 MHz. Resonant frequencies of LC networks ditto.
196 **95¢**

BABANI BOOKS —direct

RIGHT HERE!

PRACTICAL TRANSISTORISED NOVELTIES FOR HI-FI
Circuits for audio power meter, stereo 'phone adaptor, multi-channel mixers, gain control, contour network etc. etc.
201 **$1.30**

HI-FI LOUDSPEAKER ENCLOSURES
Data for building corner reflex, bass reflex, exponential horn, folded horn, tuned port, Klipschorn labyrinth, tuned column, loaded port and multi speaker panoramics. Clear dimensioned diagrams included.
205 **$3.20**

DIODE CHARACTERISTICS, EQUIVALENTS & SUBSTITUTES
Includes signal, zener, rectifier diodes etc. Full interchangeability data and characteristics of thousands of diodes of all types with every possible alternative. Includes UK, USA, European, Russian, and Far Eastern devices.
211 **$4.20**

ELECTRONIC CIRCUITS FOR MODEL RAILWAYS
Constructional details of a simple model train controller, a controller with simulated inertia, a high-power controller, an electronic steam whistle and a 'chuff gerferator'. Signal systems and train lighting and RF suppression also covered.
213 **$3.40**

AUDIO ENTHUSIASTS' HANDBOOK
Discusses audio and hi-fi topics including record/playback curves, stylus compliance, disc recordings — then and now, evaluating loudness, equipment compatibility, acoustic feedback, equipment performance figures and standards etc. etc.
214 **$2.90**

SHORTWAVE CIRCUITS & GEAR FOR EXPERIMENTERS & RADIO HAMS
This practical little book covers a whole variety of useful items of equipment of interest to the hobbyist interested in shortwave radio, TV, FM, amateur radio, etc. All coil and component data is included and parts are generally locally available, so constructors should have little difficulty in building projects from this book. Antennas are covered also.
215 **$2.90**

BUILD YOUR OWN ELECTRONIC EXPERIMENTER'S LAB USING ICs.
Includes many circuits and designs for constructing test and measuring instruments mostly using modern ICs. Includes AF osc, TTL pulse detector, hi-impedence Vm, square-wave osc/pulse gen, logic probe, lo-range ohmmeter, bridge, signal tracer etc.
218 **$2.90**

SOLID STATE NOVELTY PROJECTS
A number of novelty projects using modern ICs and transistors. Includes 'Optomin' - a musical instrument played by reflecting a light beam with your hand, water warbler for pot plants, music tone generator, LEDs and ladders game, touch switch, electronic roulette wheel etc.
219 **$2.90**

BUILD YOUR OWN HI-FI & AUDIO ACCESSORIES
Essential for keen hi-fi and audio enthusiasts. Projects include stereo decoder, three-channel mixer, FET preamp for ceramic pick-ups, mic preamp with adj. bass, stereo dynamic noise limiter, loudspeaker protector, voice-operated relay, etc.
220 **$2.90**

28 TESTED TRANSISTOR PROJECTS
Some circuits are new, others are familiar designs. Projects can be split and/or combined for specialised needs.
221 **$4.20**

SOLID STATE SHORT WAVE RECEIVERS FOR BEGINNERS
Design and construction of several solid-state short-wave receivers giving high level of performance yet utilising relatively few inexpensive components. See also 226.
222 **$4.20**

50 PROJECTS USING CA 3130 ICs.
The CA3130 is an advanced operational amplifier capable of higher performance than many others: circuits often need fewer ancillary components. Interesting and useful projects in five groups. Audio projects. RF projects. Test equipment. Household projects. Misc. projects.
223 **$4.20**

50 CMOS IC PROJECTS
Many interesting and useful projects — multivibrators, amplifiers and oscillators; trigger devices; special devices.
224 **$4.20**

PRACTICAL INTRO TO DIGITAL ICs
Introduction to digital ICs (mainly TTL 7400). Besides simple projects, includes logic test set to identify and test digital ICs. Also includes digital counter-timer.
225 **$4.20**

HOW TO BUILD ADVANCED SHORT WAVE RECEIVERS
Full practical constructional details of receivers with performance equal to commercial units. Also 'add-on' circuits of Q meter, S meter, noise limiter etc.
226 **$4.05**

BEGINNERS' GUIDE TO BUILDING ELECTRONIC PROJECTS
Enables total beginners to tackle electronic projects. Includes component identification, tools, soldering, building methods, cases, legends etc. etc. Practical basic projects are included.
227 **$4.20**

ESSENTIAL THEORY FOR THE ELECTRONICS HOBBYIST
This book supplies hobbyists with background knowledge, tailored for his or her specific requirements and presented in a readable manner with minimum maths. Purpose-designed examples illustrate applications.
228 **$4.20**

Prices now reduced!

ORDER FORM

Please forward

Book	Qty		
BP2	...	201	...
BP7	...	205	...
BP23	...	211	...
BP24	...	213	...
BP27	...	214	...
BP33	...	215	...
BP36	...	218	...
BP37	...	219	...
BP38	...	220	...
BP40	...	221	...
BP41	...	222	...
BP42	...	223	...
BP43	...	224	...
BP47	...	225	...
BP48	...	226	...
BP49	...	227	...
196	...	228	...

Trade enquiries welcomed

Send to ETI Book Sales, 4th Floor, 15 Boundary St, Rushcutters Bay NSW 2011.

Please allow 4-5 weeks for delivery.

Post & handling:

1 - 4 books:	$1.35	11 - 20 books:	$3.50
5 - 10 books:	$2.70	over 20 books:	$5.00

I enclose $ ..... **(inc. p & h.)**

Name .....

Address .....

.....

..... **Postcode** .....

from ETI

THE S-100 BUS MULTI USER EXPERT

Compu Tailor Pty. Ltd.
NORMANBY CHAMBERS, 430 LITTLE COLLINS STREET, MELBOURNE, 3000
Telephone: (03) 602 3946

We are skilled specialists in customized software and hardware computer systems.
We provide a generous guarantee, full maintenance and a satisfying back up service for all our customers.

*** **COMPUTAILOR 282 SYSTEM** ***

*** **ALL THESE FEATURES** ***
*** **IN THIS SMALL SPACE** ***
*** **AT THIS LOW PRICE** ***
*** **$4495** ***

THIS LOW PRICE VALID FOR THE MONTH OF DECEMBER ONLY

Greater computer power — fewer separate components — S100 Bus
Multi-user capability — simple to operate — modular maintenance.

As your requirements grow, the Computailor 282 System can grow.

Features:

Processor	Z80A — operating at 4MHz.
Memory	64K RAM (200nS) bank selectable, 2K Monitor and 2K BIOS in PROM.
Interface	Two (2) Ports: 1xRS-232C Serial I/O (Usually used for a Display Unit) 1xParallel I/O Port (Usually used for a Printer)
Options	CP/M 2.2 DOS, MP/M II multi-user operating system, Word Processor, BASIC, Fortran, Pascal, Accounting System: G/L, A/R, A/P, P/R, I/C etc.

Phone, write or call for a descriptive bulletin and specifications.

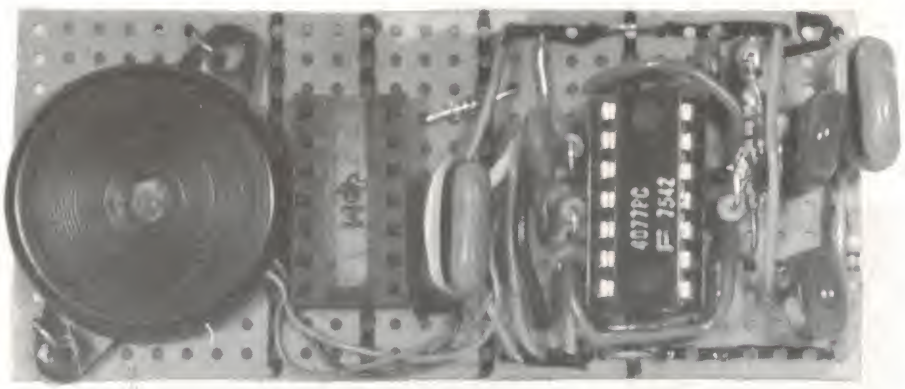
Ask for our short form catalogue.
All prices are tax free; add 17½% sales tax if applicable.
Mail orders are welcome, add postage.

Prices and specs. subject to change without notice.

bankcard welcome here

Keyboard beeper for the Exidy Sorcerer

This ultra-simple circuit for your computer beeps to alert you that the machine is ready for your next entry. It uses only one IC and no software is required.



I built my keyboard beeper on Veroboard, which results in a compact assembly, and mounted it inside my Sorcerer (see later photos).

Graham Wideman

SITTING IN FRONT of a computer monitor for long periods of time can be eyestrain enough, without having to watch the screen attentively to ascertain when the machine is ready for your next key entry. This is particularly so if there are lengthy calculations, disk or cassette accesses to be performed between keyboard inputs. To relieve this tedium it is a good idea to equip your machine with a beeper which prompts you when the machine is ready. Such a circuit is described here, which although specifically tailored to the Exidy Sorcerer is applicable to most other machines too.

How does it know when to beep?

Our beeper must somehow know when to beep. One possible approach would be to write the software which reads the keyboard in such a way that some output is activated before a key is read to trigger the beeper. This is however not feasible for use with most personal computers, whose keyboard reading program is in ROM and hence cannot be readily modified. The approach we take here is a completely hardware one.

The typical computer program, be it yours or the built-in monitor or BASIC, proceeds as follows. First some processing, then look at the keyboard. And keep on looking at the keyboard until a key is picked up. Then do some more processing and again look at the keyboard. And so on. We want the beep to sound when the software looks at the keyboard. But when the software is looking at the keyboard, it is actually sampling the keyboard perhaps hundreds of times per second. So we can't have the beeper triggered every time the keyboard is sampled, or the beeper would be on continuously if you didn't hit a key. So the beeper must be triggered when the software *starts* to look at the keyboard. An easy way to detect this, it turns out, is to figure out when the software is *not* looking at the keyboard, and then beep when the keyboard starts to be looked at again.

What kind of keyboard?

Two kinds of keyboard systems are in common use, 'hardware-scanned' and 'software-scanned'. The hardware-scanned type is conceptually easier to understand. In this design the keyboard circuitry actually looks at all the keys, and when a key is pressed the code for that key is stored in a latch. When the software gets around to needing some keyboard input (which may occur hundreds of times per second if you are just entering text, for example) it looks at that latch and if there is something in it that keycode is taken and used. In this case we can know if the software is asking for keyboard input by looking at the signals associated with reading the keyboard latch.

Our circuit was primarily intended for the Sorcerer, however, which like many personal computers has a software-scanned keyboard. In this case there is no latch whose signals we could use to determine if the keyboard is being looked at. However, because the keyboard scanning is done by the software, no scanning is being done when the software is busy doing something else! Thus if we look at one of the scan outputs and can distinguish scan and no-scan conditions, we'll be able to make the beeper know when to beep. In the Sorcerer's case there are four such scan output lines which determine which column of keys is being looked at. (Electrically speaking, Sorcerer has five rows of 16 keys, with some missing.)

Scan to beep

The scan line that we choose is normally 'low' when the keyboard is not being scanned, and rapidly alternates low and high during scanning. The input to our beeper circuit distinguishes between these two cases, and triggers the beeper if the scan line has been low for longer than a preset length of time. There is

something of a trade-off to be made here, since if this preset time is too short a beep will sound for ordinary typing (the scanning stops during the time a key is held down), and if too long the beeper will not usefully alert the operator. The components shown should give a good compromise.

The circuit also contains the timing components, which give a beep length of about 0.2 sec. Finally, the beep feature may be turned on or off by depressing one or other of the Sorcerer's two reset buttons. *(Not both!!)*

How it works

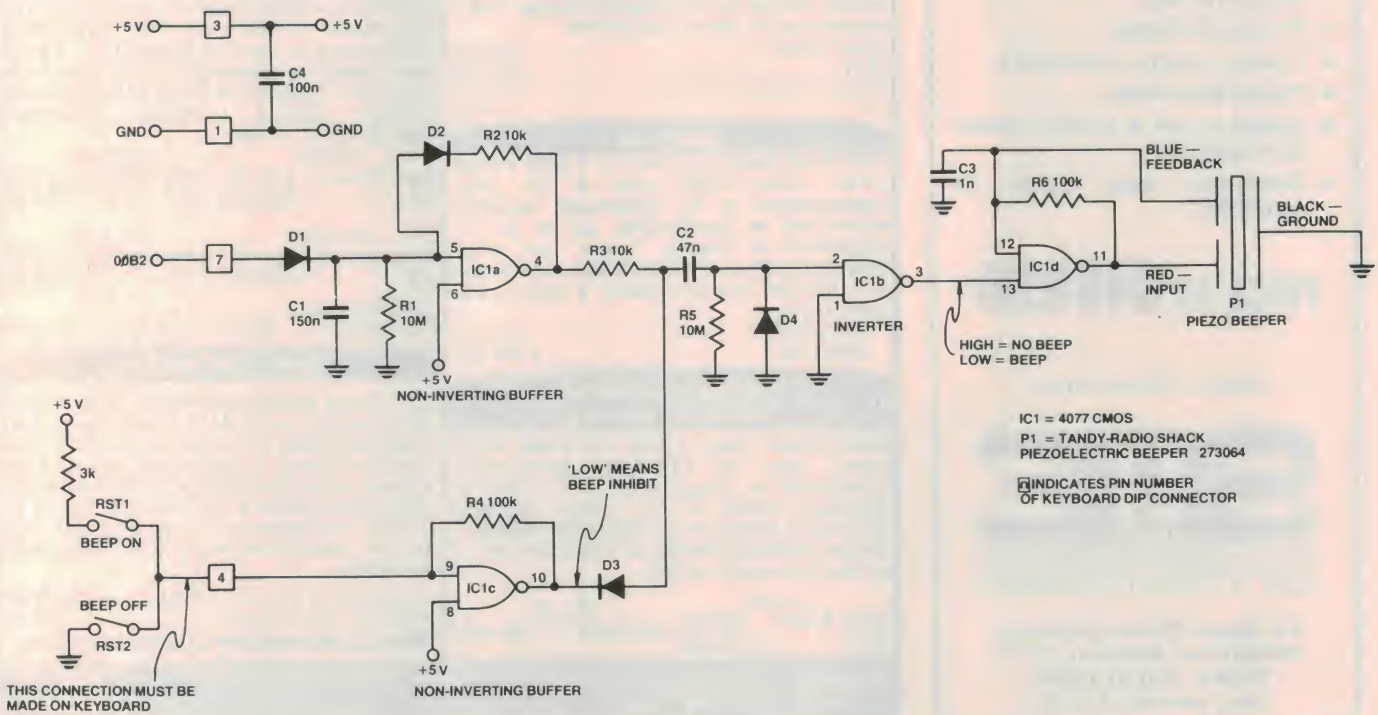
A very handy tip to remember when trying to design a project with a minimum number of ICs is that both inverters and non-inverters can be 'made' from exclusive-OR (XOR) gates, and also from inverting XOR gates (XNOR). In this case we have used a CMOS 4077 quad two-input XNOR IC. If one of the inputs to this gate is tied high (+5 V) then the output will be the same as the remaining input. If one input is tied low the output is the inversion of the other input.

First we'll deal with the scan detection circuitry involving IC1a, which is wired as a non-inverting buffer. Under normal scanning conditions the scan input (00B2 in Exidy's notation — bit 2 of output port 0FEH) will rapidly alternate between high and low states. Each time it goes high C1 is charged via D1. During scanning the time interval between charging pulses to C1 is so short as not to allow C1 to discharge very much, and consequently IC1a pin 5 is held high, resulting in IC1a pin 4 also being high. If scanning stops, as during lengthy processing or disk or cassette access, C1 slowly discharges via R1 until the voltage on C1 gets to the threshold where IC1a thinks input pin 5 is low. When this happens output pin 4 goes low. C1 is now quickly further discharged via D2 and R2, ensuring a sharp high-to-low transition. When scanning recommences, C1 is again charged and IC1a pin 4 again goes high. It is this low-to-high transition which is eventually to trigger the beeper.

Assuming that IC1c pin 10 is high and thus D3 has no effect on the signal at the junction of R3, C2 and D3, the aforementioned low-to-high transition will be transferred via C2 to the input pin 2 of IC1b. Since IC1b is connected as an inverter this will cause its output (pin 3) to go low. But pin 2 will be dragged low after about 0.2 seconds or so by R5, this in turn returning pin 3 to the high state. What has happened then is as follows: resumption of scanning after a short non-scanning period causes a 0.2 s pulse low at IC1 pin 3. This pulse is to turn on the beeper for its duration.

The beeper circuit itself involves IC1d and the piezoelectric element P1. P1 has three connections, an input, a ground, and a feedback terminal. In order to generate a sound it is necessary to apply a signal of the piezo crystal's resonant frequency to the input, to make it resonate (somewhere around 6.5 kHz). You don't have to guess this frequency, however; it is merely necessary to arrange the piezo element to be in the feedback loop of an inverting amplifier circuit, and the whole combination will resonate away at the appropriate frequency. When IC1 pin 13 is low IC1d acts as an inverter, and with its output driving the piezo element and the element feedback terminal connected to IC1d's inverting input, a beep results. When IC1 pin 13 is high, as is normal, IC1d becomes a non-inverter, and no sound emits, or at least it shouldn't. However, with some IC and beeper combinations it still oscillates, so C3 and R6 are included to dampen this oscillation and only allow the desired beep to come forth.

IC1c acts as a flip-flop. If RST2 is depressed pin 9 is forced low, causing pin 10 to go low. When RST2 is released, pin 9 will still be held low by R4 connected to pin 10. If RST1 is depressed, pin 9 will be pulled high. The pulling up via the Sorcerer's internal Reset line pull-up resistor (about 3k) vastly outweighs the pull-down influence of R4 (100k), while R4 has almost no pull-down effect on the Sorcerer's Reset line. So, with pin 9 pulled high, pin 10 also goes high, and now when RST1 is released pin 10 stays high. If pin 10 is high no current can ▶



SBC 800

SBC-800 SINGLE BOARD COMPUTER

FEATURES:

- ★ S100 Bus compatable.
- ★ Z80 CPU running at 4MHz
- ★ CMOS battery backed ram from 2K to 6K.
- ★ 2716/2732 EPOM from 2K to 12K.
- ★ 2-RS232 Serial I/O ports +20 Ma current loop.
- ★ 3-8 Bit programmable I/O ports.
- ★ 1-Centronics parallel printer port.
- ★ Real time clock & calendar — battery backed.
- ★ 4 Channel 16 Bit counter timer (Z80 CTC).
- ★ Vectored interrupt chain via CTC & Dart chip.
- ★ All on board memory can be disabled for 64K ram use.
- ★ 2K Monitor EPROM supplied.
- ★ Software programmable baud rate generator.
- ★ Power fail detect.
- ★ Power on jump to Monitor.
- ★ Plated thru holes.
- ★ Solder resist & green printed parts overlay.
- ★ **Designed and made in Australia.**

PRICE AT $495.00

Hours — 9 a.m.-5 p.m.

SME SYSTEMS

22 Queen Street, Mitcham, Melbourne, Australia, 3132
Phone: (03) 874 3666
Telex: SMELEC AA37213

S100 SPECIALIST

COMPUTER SYSTEMS (AUST.)

283 CLARENCE ST
SYDNEY NSW 2000
TEL: 29-2402, 922-1709
ASSOCIATED WITH QT USA

SYSTEM + II (2MB +)

Computer System with 8" Dual Sided Drives (uses Y-E DATA YD174 Disk Drives) Terminal not included.

A&T (6 slot) $3883.00
A&T (8 slot) $4083.00

MINI-SYSTEM + (½MB +)

Computer System with 5¼" Single Sided Drives (uses TEAC FD-50A Disk Drives) Terminal not included.

A&T (6 slot) $3048.00
A&T (8 slot) $3073.00

QT Systems are designed for both businessmen and engineers in accordance with the latest IEEE standards. Among other functions, they can be used for accounting and word processing as well as a variety of scientific applications. The systems are available with MP/M or OASIS operating systems to allow multi-user, multi-tasking operations. QT also offers a full line of business and applications software, ranging from a business package to word processing.

Technical specifications: 4 MHz Z-80 CPU • Dbl-sided, dbl-den. 5¼" or 8" floppy disk controller (handles both drives simultaneously) • CP/M 2.2 included • 64K RAM, expandable per your requirements • Comes complete in single mainframe • RS232C serial port • Parallel port • Hard disk compatible • Monitor program & disk routines included on EPROM • Power-on/reset jump to monitor program • Documentation included. • Extensive software available

SOFTWARE +

Word processing • System utilities and diagnostics • Games • CP/M users group diskettes $10.00 each, catalogue $6.00 • Pascal, Forth, Tarbell Basic, Fortran, and most other compilers and utilities are available • Complete range of business software • Custom programming can be arranged on a fixed price or hourly basis.

PERIPHERALS +

We have fantastic specials on printers, terminals and disc drives. Also card cages and mainframes. Call or write for details and pricing.

Hazeltine terminal $995
M8500 Graphics printer $795
YD-174 DS/DD Drives $625

NEW! 64K MEMORY BOARD

64K Static RAM uses 2016 new static rams, or 2716 EPROMS • Provides extended address decoding and fast 4 MHz operation • Extremely low power

64K - A&T $639.99

SBC +¾ SINGLE BOARD COMPUTER

1K RAM (which can be located at any 1K boundary) plus one each serial and parallel I/O ports • Power on jump to on board EPROM (2708 or 2716) addressable on any 1K or 2K boundary • Full 64K use of RAM in shadow mode • Programmable Baud rate selection 110–9600 • 2 or 4 MHz switch selectable • DMA capability allows MWRT signal generation on CPU board or elsewhere in system under DMA or front panel control • Two programmable timers available for use by programs.

Bare board $66.00
A&T $269.00
Monitor Eprom (2716) $30.00
Kit $199.00

DYNAMIC MEMORY BANK — 64K OR 256K

Up to 6MHz operation • Supports 8 bit and 16 bit processors, port addressing or 24 bit address lines • Transparent refresh works with DMA.

64K A & T $667.00
QT REV 1 B/B $81.00
REV 1 64K A & T $425.00

RAM + 16

16KX8 bit static RAM • 2 or 4 MHz • Uses 2114 static RAM chip • 4K step addressable • 1K increment memory protection • Deactivates up to six 1K segments to create "holes" for other devices • DIP switch selectable wait states • PHANTOM line DIP switch • Eight bank select lines.

Bare Board $41.00
4MHz A&T $199.00

SILENCE + MOTHER BOARD

These mother boards are among the quietest on the market • A unique grounding matrix — with each line completely surrounded by ground shielding — eliminates need for termination and give high crosstalk rejection • They are customer proven, without crosstalk sometimes operating at 14 MHz.

6 SLOT		8 SLOT	
Bare Board	$31.00	Bare Board	$33.00
A&T	$61.00	A&T	$84.00
12 SLOT		**18 SLOT**	
Bare Board	$39.00	Bare Board	$61.00
A&T	$108.00	A&T	$168.00

S100 Sockets—
Gold Plated ..... $6.20 Nickel/Tin $5.00

CLOCK/CALENDAR S-100 OR TRS-80

Date/Month/Year • Day of week • 24 hours time or 12 hours (a.m./p.m) selectable • Leap year • 4 interval interrupt timers • On board battery backup • Simple time and date setting • Simple software interface • Time advance protection while setting.

S-100		TRS-80	
Bare Board	$66.00	A&T only	$167.00
A&T	$162.00		

DISK CONTROLLER

CCS2422A features ROM bootstrap loader and monitor • CP/M 2.2 with documentation included • Accepts 5¼" and 8" disk drives • Double sided/single sided select • Read/write IBM 3740 or system 34 single or double density • Fast seek available for voice coil operation • Automatic disk density determination • ROM bootstrap phantom.

CCS2422A A & T Incl. CP/M 2.2 ..... $399.95
JADE DD Bare Board $85.00

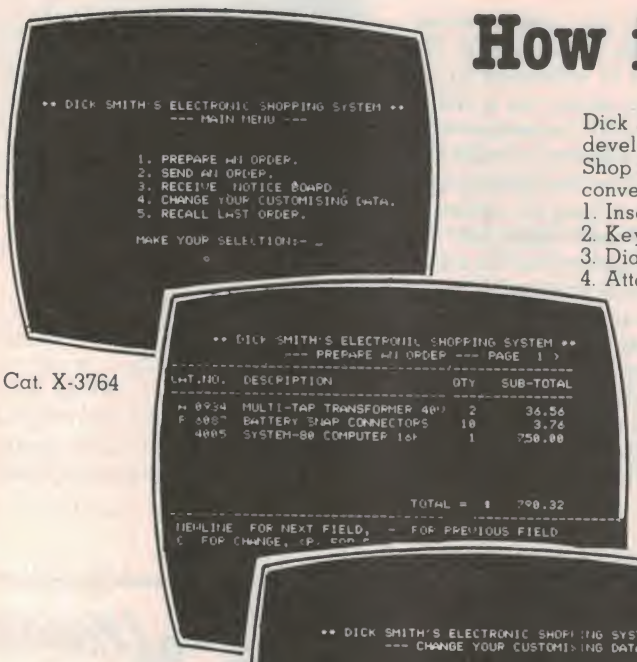
SEND S.A.E. FOR FREE COPY OF LATEST CATALOGUE.

PRICES DO NOT INCLUDE SALES TAX OR DELIVERY, AND ARE SUBJECT TO CHANGE WITHOUT NOTICE.•

While everyone is still talking, Dick Smith has done it!

Electronic shopping in your own home

How it works



Cat. X-3764

Dick Smith's new Electronic Shopping System is a revolutionary development which really brings buying into the 21st Century. Shop from your home, day or night, anywhere in the world, from the convenience of your own computer. All you do is this:

1. Insert your program disk into the disk drive.
2. Key in your order on your own computer.
3. Dial the special Dick Smith computer phone number.
4. Attach your phone to the acoustic coupler (modem).

Your order is then transferred directly onto the Dick Smith computer. It's as simple as that!

The program not only allows you to place an order with Dick Smith Electronics in less than 90 seconds, but also enables you to leave a message with your order. The computer isn't just for buying either! You can use it to call up our computer, at any time to see the information in the "data bank" – news of interest to hobbyists etc, information from magazines plus specials etc.

Your order is given preferential despatch treatment and will be on it's way within a few hours of it being received. Think of the time you'll save!

When you buy the Electronic Shopping System Program, you are allocated your own identification number for security and you are automatically billed via a nominated credit card account. What could be more convenient?

NO TRAFFIC HASSLES – NO LIMITATION OF HOURS!

Charge to your Bankcard – it's that easy!

What you need

- A System 80 Computer (X-4005 or 4100)
- An expansion unit and 32K Memory (X-4010 & X-4016)
- A Disk Drive and cable (X-4050 & X-3232)
- A full Duplex Acoustic Modem operating at 300 baud (X-3270)
- A Video Monitor (X-1196)
- A Jabel Mains Filter is recommended 9850).

(Or an equivalent Tandy TRS-80 computer system.)

A special program for your computer:

To use this unique system, you'll need a special program diskette for your computer. This has been specially developed for Dick Smith and, in order to allow the maximum number of people the benefits of this system, it is being released at less-than-cost price. Along with this diskette, a special security account number is issued so you can use the system without fear of unauthorised usage. It's yours and yours alone.

DSE 091 RB

EXCLUSIVE TO

DICK SMITH ELECTRONICS

● SYDNEY ● WOLLONGONG ● NEWCASTLE ● CANBERRA ● MELBOURNE ● ADELAIDE ● PERTH ● BRISBANE

Post this coupon today! PO Box 321, North Ryde 2113 Phone (02) 888 3200

YES! I'm ready for 21st Century computer shopping. I want to be among the first in the world to use the Dick Smith Computer Shopping System

I understand that for the one-time fee of $5.00, I will receive a program diskette enabling me to use the system, plus a unique security number to prevent unauthorised use by others and the special telephone number. (Full details of the system are supplied with the diskette)

My name: .....

Address .....

(A street address is necessary if despatch methods other than Australia Post are required – e.g. Road or Air Freight)

My Bankcard No: ..... Expiry Date:...../...../....

(Goods ordered on this system will be charged to this bankcard)

Signature: .....

My $5.00 fee is enclosed in the form of:

☐ Cheque ☐ Postal Order ☐ Bankcard account above.

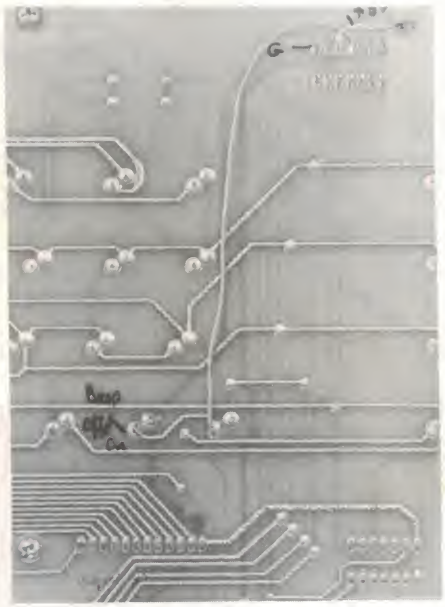
flow through D3 and there is no effect on the beep-triggering signal at R3-C2. However, if pin 10 is low, R3-C2 will be held low, and as a result no beeps can be triggered. RST2 is then the beep-inhibiting button, and RST1 the beep-allowing key.

Mounted inside the Sorcerer.

There are two time constants which you can adjust to suit your preference. If your beeper is too prone to emit annoying beeps during ordinary typing, increase the value of C1. If it has the opposite fault, and instead doesn't beep unless there has been a very long no-scan interlude, decrease C1. If that part of the circuit is OK but you'd like a longer beep, increase C2, vice versa to shorten.

Construction

The prototype for this simple circuit was built on a piece of Veroboard. The Sorcerer keyboard is connected to the main computer pc board via a ribbon cable with a 14-pin DIP connector on the computer end. We soldered a 14-pin DIP 'header' (bare plug) on the bottom of the Veroboard, and a 14-pin IC socket on the top. The keyboard plugs into the beeper, which then plugs into the socket on the main computer pc board. It is also possible of course to simply screw your beeper board onto the keyboard pc board. All the necessary connections can be made to the ribbon cable connector at the keyboard end, or the computer end, which is what makes the plug-in idea neat. However, one connection must be made elsewhere, which is to the common connection between the two reset switches. If the plug-in design is used then it will be necessary to connect this point to the unused wire in the ribbon cable, which is available at pin 4 of the DIP connectors at each end. ●



Connection to the common of the reset switches.

The Personal Computer
Your information window

An extension of your brain
An Apple Personal Computer puts you at the forefront of the technological revolution. Use it well and it will mediate the availabilities of a wealth of conceptual tools, data bases, communication channels and information processes. An Apple will help you simplify a myriad of tasks from ordinary data processing through information retrieval to economic forecasting.

Apple is versatile
Your Apple is an extremely powerful and robust problem solver backed by a comprehensive set of software programmes. Already, over 300,000 Apples are used for business, domestic, educational research and recreational purposes.

Apple as information processor
An Apple personal computer performs a full range of standard functions like statistics, word-processing, graphics, number crunching, filing, storage/retrieval and cross-referencing.

Apple as super-brain
Aside from the more pedestrian functions of retrieving and processing information, Apple performs other sophisticated functions such as econometric modelling, financial forecasting, graphics, topological modelling and trend analysis.

Apple is convenient
Apple is portable. It can be used at home or in the office. You can address it in ordinary English or gain full computer literacy in BASIC PASCAL, COBOL, FORTRAN or PILOT. Full step-by-step training comes with your Apple. If you can use a calculator and speak English, Apple shows you the rest.

Apple as communicator
Apple combines many of the functions of telephones, telexes, citizens' band radios and library access terminals.
It allows you the very latest access to data bases and information services and mail electronically locally or world wide.

Apple as challenger
Apple is fun. From a perfect game of Chess to Star Wars—not only for the children—preparing them for the future in this high-technology age.

Apple is cost-efficient
For roughly the price of a plain paper copier, you get a sophisticated, powerful machine, which not only processes numbers and words, but gives you direct access to a wealth of information through a rich network of data bases and direct communications with other computers.

Mail this coupon for an "Apple Pack" brochure or talk to your local Apple authorised dealer about the specific applications for you.
If the coupon has been removed, send your name and address to:
ELECTRONIC CONCEPTS PTY LTD,
55 CLARENCE STREET,
SYDNEY, NSW 2000

apple computer®

Mail to: PPCB374B
ELECTRONIC CONCEPTS PTY LTD,
55 CLARENCE STREET, SYDNEY, NSW 2000
Please send me a free "Apple Pack" brochure.

NAME _____

ADDRESS _____

_____ POSTCODE _____

PROFESSION _____

APPLE APPLE = PERSONAL COMPUTER PERSONAL COMPUTER = APPLE APPL

TOP QUALITY AND BEST SERVICE!

Two Good Reasons to Buy from Us!

Fairchild's FAST family of Advanced Schottky TTL logic has arrived. Twenty-one products are currently available that deliver up to 75% more speed than Low Power Schottky, and up to 40% more speed than Schottky. At up to 75% reduction in Schottky power. We owe all of these improvements over previous TTL families to one thing. Our proven Isoplanar process.

Take a fast look at what we have.

There are six multiplexers to choose from, with typical select to output of 8 ns at only 70mW. Two flip-flops and two counters are available with toggling capability in excess of 120 MHz. We have an ALU that's 40% faster than its Schottky counterpart, yet requires only ⅓ the power.

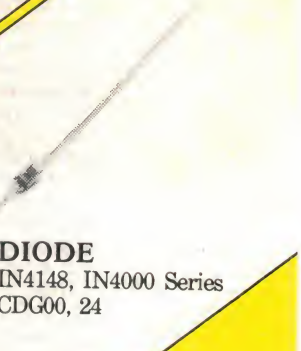
If you need a high-speed shift register, ours has a shift frequency of 150 MHz. Or an octal latch that has a propagation delay of less than 4 ns. An octal buffer with ½ the power of its Schottky counterpart and full 64 mA drive capability. Plus six gates to help put them all together.

When you want it fast, we've got it.
And at the right prices for the Australian O.E.M.

CMOS
4000 Series
High Speed
Silicone Gate

LINEAR
UA555V

TTL
F7400 Series
F9LS00 Series



DIODE
IN4148, IN4000 Series
CDG00, 24

Regulator
UA 78H05SC
HYBRID

TO-92
CS9000
Series
PN3569/
4355

LED Display
Man-72, 73 & 74

If your're looking for LCDs, LEDs, linear products, hybrids, microprocessors, LSIs, bi-polar LSIs, CCDs, CMOS, TTLs, discrete components, or whatever — ellistronics has the technological and merchandising experience to give you what you need, when you need it.

We've been providing top-quality components for a number of years now. As recently appointed distributors for Fairchild, we're able to offer you an even more comprehensive range of products than ever before — with the very latest technologies available!

We have large inventories on hand, to ensure prompt deliveries, and have the technological backup to help you solve application problems. Contact us for more details.

Ex-Stock!

FAIRCHILD

A Schlumberger Company

Distributors of Fairchild

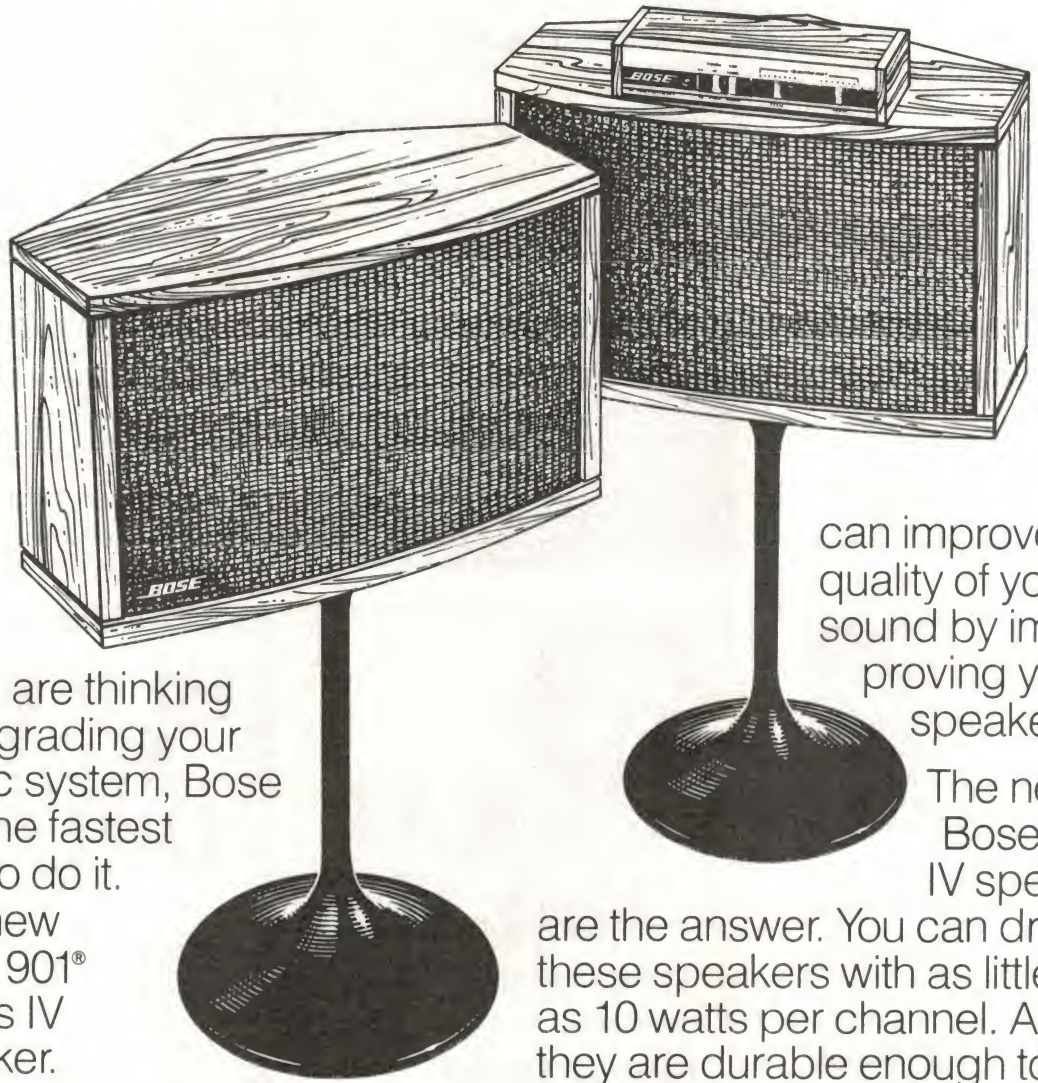
ELLISTRONICS PTY. LTD.

289 LATROBE ST., MELBOURNE, 3000
(03) 602 3282. 602 3836. Telex AA37758 LSTRON

Also Distributors for ELECTROLUBE
CAMBION — WELLER — S.G.S. ATES FERGUSON
HITACHI — TRIO — FLUKE — O.K. WIRE WRAP SYSTEMS
ADCOLA — ELLISTRONIC BREADBOARD AND LOGIC PROBES ETC.

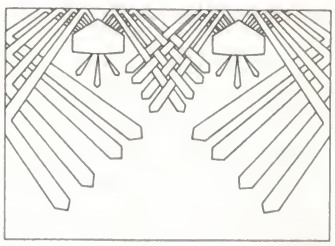
The instant upgrade.

The new Bose® 901® IV Direct/Reflecting® speakers help your stereo sound better.



If you are thinking of upgrading your music system, Bose has the fastest way to do it. The new Bose 901® Series IV speaker.

Since the speaker has more to do with the sound you hear than any other part of your music system, you can improve the quality of your sound by improving your speakers.



The new Bose 901® IV speakers are the answer. You can drive these speakers with as little as 10 watts per channel. And they are durable enough to handle any non-commercial amp. So you can match them to your system, no matter what the system.

The Bose 901® Series IV speaker. The best regardless of size or price.

BOSE®

111689-9/78-11

BOSE AUSTRALIA INC., 11 MURIEL AVENUE, RYDALMERE, NSW 2116.
TELEPHONE (02) 684-1022, 684-1255.

SIGHT & SOUND

Blank tape levy — inquiry urged

Following the Attorney-General's announcement that audio visual provisions of the Copyright Act will be reviewed, the Australian Audio-Video Tape Association (AAVTA) is urging a public enquiry on this whole subject.

The AAVTA represents the magnetic tape industry, with member companies including 3M, TDK, Ampex, Greencorp, BASF, Fuji, Maxell and Agfa.

The Association believes that consumers are likely to be forced to pay the penalty of heavy levies on all audio and video cassettes if Government approval is given to proposals suggested by representatives of the Australian Copyright Council in a lengthy report recently presented to the Attorney-General's Department and at a Symposium on October 1 and 2 at the Opera House on 'Copyright and Technology'.

The AAVTA points out that no consumers or consumer groups are represented on the Council to provide the Government with a balanced input for the proposed copyright review.

To date much of the argument of copyright owners and the record industry hinges on claims that they have suffered substantial losses directly attributable to the ability consumers have to easily re-record copyright material.

The AAVTA believes that copyright owners have benefited enormously from new technology, in that it has given them a far wider audience and medium for propagation of their work. An AAVTA spokesman says that any proposals which seek to discourage private recording by the imposition of a penalty or levy would have an opposite and limiting effect upon the popularisation of works.

Similar attempts to impose levies on blank tapes have been made in other countries, and no country with British law has introduced legislation which provides for a levy on goods where it might be possible to breach copyright.

In the UK Government's long-awaited Green Paper on copyright reform, the Government says it has received no convincing evidence that a levy on audio or video hardware or on blank tapes should be introduced. It goes on to say the Government would hesitate to impose this on the public, especially since the imposition of a levy would involve 'rough justice', with many tape users who do not record copyright material having to pay.

The AAVTA claims it does not endorse piracy of copyright material which involves systematic illegal duplication for financial gain, saying the main use of home video recorders and tape decks is to 'time shift' and be able to watch and listen to programmes at a more convenient time than when they are broadcast.

The Association believes that single copying of this nature for private and domestic use is no more an abuse of the rights of copyright owners than is the current trend towards the legitimate use of home video films rather than Super-8 home movies, or the sending of privately recorded audio cassettes rather than letters. It believes that neither of these quite reasonable practices should be penalised by the imposition of a blanket tax or levy on all cassettes.

Copyright Acts in all countries which are contracting parties to international copyright conventions, like Australia, permit overseas governments reasonable freedom to set their own laws regarding what constitutes valid non-infringing use for private and domestic purposes, or for the purposes of education and research. The AAVTA believes that now is the time for the Commonwealth Government to legalise single copy domestic use that does not result in any financial gain for the consumer, and believes that copyright owners will not suffer if this is done.

The AAVTA points out that there are many other complex issues which must be considered in relation to the proposed amendments to the audio-visual copyright. As all of these issues affect the consumer, the Association claims they must be debated publicly, rather than be considered on the basis of a minimal number of written submissions by bodies such as the Copyright Council, whose stance on the subject the AAVTA claim amounts to the type of 'rough justice' rejected by the UK Government only a few months ago.

The Association believes that a public hearing should be arranged, preferably along the lines of an IAC enquiry. For further information contact Mr. Peter A.G. Rose, Vice-Chairman and Spokesman, Australian Audio-Video Tape Association, c/o 3M Australia, 950 Pacific Hwy, Pymble NSW 2073. (02)498-0033.

ITT moves towards digital television

ITT Semiconductor headquarters in Germany have made an important move towards digital television by producing an experimental colour receiver which operates from digital signals. The company intends to supply this type of receiver to its main customers by the end of 1981.

ITT has been looking into the idea of digital television since 1977, but design work for the VLSI devices required began only about a year ago. Digital signal processing is employed in the video processor, in the deflection unit and in all audio circuits following the discriminator. In addition, all control functions are digital.

It is anticipated that the new design will have an enormous impact on television production. The number of separate components that are required is dramatically reduced and computer adjustment of the receivers during the production process is greatly simplified.

Digital test signals can be monitored and adjustments made automatically by incorporating the adjustment program on a PROM or EPROM within the receiver. This is far easier than using the adjusting potentiometer required on analogue receivers and does not require the same investment for mechanical tooling for automation.

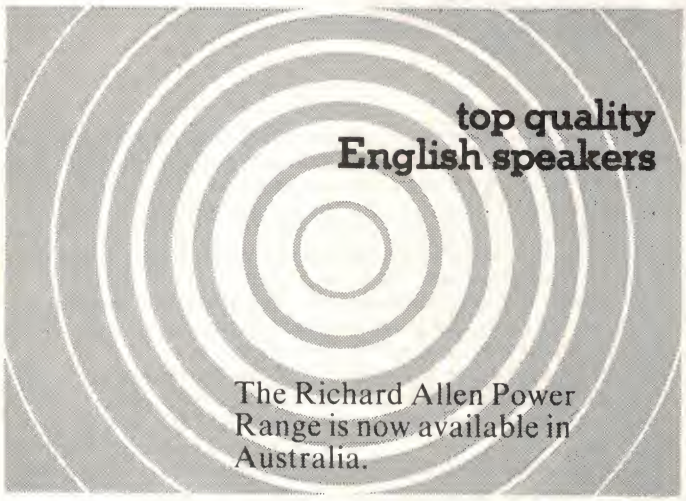
The prototype receiver is based on VLSI chips. Although ITT have not stated the number of such chips used in their receiver, it is far less than the number of components in the conventional analogue receivers currently in production (typically some 300 passive components, 60 transistors and about 12 ICs).

ITT hope that the digital television receiver will provide the European market with highly cost-effective production of receivers, which will make the industry far more competitive in the world markets. Several Japanese manufacturers have already expressed an interest in the ITT concept, because they appreciate its importance and possible influence on world markets.

Brian Dance

Forging new frontiers in speaker performance

Richard Allan



MODEL	POWER HANDLING RMS WATTS	SENSITIVITY PEAK
Atlas 10	125	110
Atlas 12	125	110
Atlas 15	250	110
Atlas 18	250	108

Professional advice on all facets of speaker design and construction available. Come and inspect our unique experimental speaker design facility.

The **ACOUSTIC FOUNDRY** Hi Fi

56 King William Road, Goodwood 5034
(08) 2710276.

Please forward me further details on Richard Allan speakers.
(Trade enquiries also welcome).
(Please include a note specifying area of interest)

NAME .....

ADDRESS .....

.....

..... POSTCODE .....

Telecommunications Division

COURSES IN ELECTRONICS AND TELECOMMUNICATIONS

at

RMIT TECHNICAL COLLEGE

The Telecommunications Division conducts Full-time and Part-time (Day & Evening) courses at Electronics Mechanic and Electronics Technician level in the following areas:

Communications — CB Radio and Broadcasting

Digital Electronics — Microprocessors, Computers, Computer Field Service

Industrial Electronics — Electronic Control Systems

Television — Colour TV Servicing, TV Studios

Other Courses offered by this Division include 35 mm and 16 mm Motion Picture Projection, Post-trade and Post-technician subjects, Advanced Audio, Video Tape Recorders, TV Antenna , Remote Controlled TV, etc.

Applications close on 15 January.

Further information is available from the Telecommunications Division, Telephone 341 2358.

RMIT

THE DOOR TO GREATER OPPORTUNITY SINCE 1887.

RMIT Technical College,
80 Victoria Street,
Carlton, 3053.
Telephone 347 7611.

9254

Electronics assembly or repair?

. . HERE'S THE ROYSTON ELECTRONICS EQUIPMENT CATALOGUE!

It's the ideal companion for every person involved with electronics assembly or repair.

36 PAGES

It's packed with tools and equipment for soldering, bonding and welding. Pliers, cutters, tweezers. Materials and equipment for making printed circuits. IC handling devices, including anti-static gear. Circuit board holders, work positioners and much, much more!

To arrange a copy, phone or write on your letterhead.

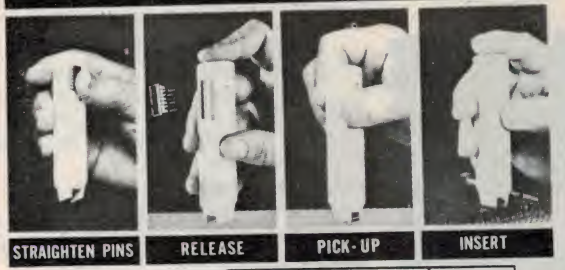
The Specialists in electronic circuit fabrication

ROYSTON ELECTRONICS

- N.S.W: 15/59 Moxon Rd., Punchbowl, 2196. Phone: (02) 709 5293
- VIC: 27 Normanby Rd., Notting Hill, 3168. Phone (03) 543 5122

TSC 812

DIP/IC INSERTION TOOL WITH PIN STRAIGHTENER



14-16 Pin Dip IC Inserter	INS-1416

36-40 PIN CMOS-SAFE IC INSERTION TOOL

Aligns bent out pins. Includes terminal lug for attachment of ground strap.

GROUND STRAP NOT INCLUDED

MOS-40	36-40 PIN CMOS SAFE INSERTION TOOL

WIRE CUT AND STRIP TOOL

Easy to operate . . . place wires (up to 4) in stripping slot with ends extending beyond cutter blades . . . press tool and pull . . . wire is cut and stripped to proper "wire-wrapping" length. The hardened steel cutting blades and sturdy construction of the tool insure long life.

Strip length easily adjustable for your applications.

DESCRIPTION	MODEL NUMBER	ADJUSTABLE "SHINER" LENGTH OF STRIPPED WIRE INCHES TO INCHES
24 ga. Wire Cut and Strip Tool	ST-100-24	1⅜" — 1¾"
26 ga. Wire Cut and Strip Tool	ST-100-26	1⅜" — 1¾"
26 ga. Wire Cut and Strip Tool	ST-100-26-875	⅞" — 1⅛"
28 ga. Wire Cut and Strip Tool	ST-100-28	⅞" — 1⅛"
30 ga. Wire Cut and Strip Tool	ST-100-30	⅞" — 1⅛"

THE ABOVE LIST OF CUT AND STRIP TOOLS ARE NOT APPLICABLE FOR MYLENE OR TEFLON INSULATION

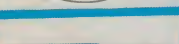
JUST WRAP™ WIRE WRAPPING TOOL

WHY CUT? WHY STRIP? WHY SLIT? WHY NOT JUST WRAP?

JW-1-B	BLUE WIRE
JW-1-W	WHITE WIRE
JW-1-Y	YELLOW WIRE
JW-1-R	RED WIRE

JUST WRAP REPLACEMENT ROLLS

R-JW-B	BLUE WIRE	50 ft. Roll
R-JW-W	WHITE WIRE	50 ft. Roll
R-JW-Y	YELLOW WIRE	50 ft. Roll
R-JW-R	RED WIRE	50 ft. Roll

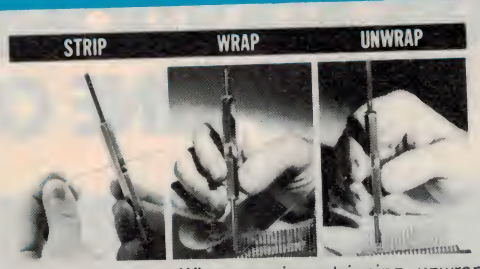


UNWRAP TOOL FOR JUST WRAP

JUW-1	UNWRAPPING TOOL

JUST WRAP KIT

JWK-6	JUST WRAP KIT



HOBBY WRAP TOOL

Wire-wrapping, stripping, unwrapping tool for AWG 30 on .025 (0,63mm) Square Post.

Regular Wrap	WSU-30
Modified Wrap	WSU-30M

WIRE-WRAPPING TOOL

For .025" (0,63mm) sq. post "MODIFIED" wrap, positive indexing, anti-overwrapping device.

For AWG 30	BW-630
For AWG 26-28	BW-2628

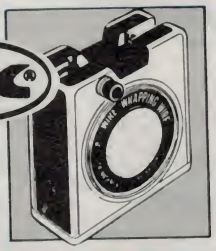
Bit for AWG 30	BT-30
Bit for AWG 26-28	BT-2628

*USE "C" SIZE NI-CAD BATTERIES (NOT INCLUDED)

ROLLS OF WIRE

Wire for wire-wrapping AWG-30 (0.25mm) KYNAR® wire, 50 ft. roll, silver plated, solid conductor, easy stripping.

30 AWG Blue Wire 50ft Roll	R-30B-0050
30 AWG Yellow Wire 50ft Roll	R-30Y-0050
30 AWG White Wire 50ft Roll	R-30W-0050
30 AWG Red Wire 50ft Roll	R-30R-0050



WIRE DISPENSER

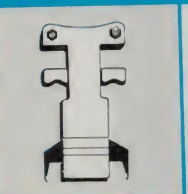
- With 50 ft. Roll of AWG 30 KYNAR® wire-wrapping wire.
- Cuts the wire to length.
- Strips 1" of insulation.
- Refillable (For refills, see above)

Blue Wire	WD-30-B
Yellow Wire	WD-30-Y
White Wire	WD-30-W
Red Wire	WD-30-R

DIP IC EXTRACTOR TOOL

Extracts all LSI, MSI and SSI devices of from 8 to 24 pins.

EX-1	EXTRACTOR TOOL



24-40 CMOS-SAFE EXTRACTOR TOOL

Removes 24-40 pin IC's, .600" centers. C-MOS safe. Includes terminal lug for attachment of ground strap.

GROUND STRAP NOT INCLUDED

EX-2	CMOS SAFE EXTRACTOR TOOL

AMPEC ELECTRONICS PTY LTD
1 WELLINGTON ST., ROZELLE 2039 PHONE: 818 1166

Available from: *NSW:* Applied Technology, 487 2711. George Brown & Co., 519 5855. Jaycar, 264 6688. Radio Despatch, 211 0191. Sheridan Electronics, 699 5922. *NSW Country Areas:* Newcastle: Elektron 2000, 26 2918. Gosford: Tommorows Electronics & HiFi, 24 7246. *VIC:* Ellistronics, 602 3282. Ritronics, 489 8131. *QLD:* L. E. Boughen, 36 1277. N.S. Electronics, 36 5061. *S.A.:* Computer Imports, 268 8065. Electronic Components & Equipment, 212 5999. *W.A.:* Altronics, 328 1599. Reserve Electronics, 275 2377. Taimac, 328 1988.

RARE ADDITIONS FROM MARANTZ. SLIMLINE COMPONENTS.

Rare: very valuable.
Addi'tions: the things added.
Ma'rantz: a range of ultra-high performance Slimline Components which blend state-of-the-art engineering with operational versatility.

MARANTZ ST450
AM/FM STEREO TUNER

Electronic Gyro-Touch tuning and digital display enable precise and speedy station selection which can be servo-locked for drift-free operation.

MARANTZ EQ20
STEREO GRAPHIC EQUALIZER

Beautifully styled, the EQ20 provides highly personalised tone control flexibility with its ten detented slide controls per channel – the perfect finishing touch to any high quality audio system.

MARANTZ SC500
STEREO PREAMPLIFIER

Traditional Marantz performance in the all important first stage of amplification. Moving coil cartridge head-amp and different cartridge load inputs are just two of the comprehensive number of facilities.

MARANTZ SM500
DC POWER AMPLIFIER

Perfectly complements the SC500 and delivers 50 watts RMS per channel. Output is displayed on two large, peak responding power level meters.

MARANTZ PM350
INTEGRATED AMPLIFIER

Bass, mid and treble controls and LED power level meters, combined with an output of 30 watts RMS per channel, make this the ideal amplifier for normal listening levels.

MARANTZ SR1100
AM/FM STEREO RECEIVER

Slim, stylish and component width, the 30 watt RMS per channel SR1100 provides a new concept in compact audio sophistication.

MARANTZ SD5010
STEREO CASSETTE DECK

Forerunner to a new generation of superior cassette decks, the SD5010 has soft-touch controls, LED meters, metal tape facility, fine bias control and an electronically controlled linear skating mechanism operating the cassette drawer.

Shown are but a few of the new Marantz Slimline Components. If you see your hi-fi as an investment and, if you demand critical performance standards as well as the best value for money, listen to the future.

Listen to Marantz.

marantz®
Now you're listening.

Distributed by MARANTZ (AUST.) PTY. LTD.
P.O. Box 604, Brookvale, N.S.W. 2100
Telephone: (02) 939 1900 Telex AA24121
Melbourne (03) 329 7655 Brisbane (07) 446 478
Adelaide (08) 223 2699 Perth (09) 276 2944

Get Santa to give you a Movie Festival for Christmas.

Imagine! All your favourite movies, to watch whenever you want! And for Santa too, it really couldn't be more convenient! Magnetic Video has them all. Beta or VHS format.

Including these Christmas releases

Return of the Pink Panther: With Peter Sellers as the nuttily notorious Inspector Clouseau in one of his best performances. (Talk about a very merry Christmas...)

Cartoon Carnival: How do you describe the crazy, crazy antics of Heckle and Jeckle, Mighty Mouse, and Deputy Dawg? It is amazing value for only $69. Previously these cartoons would have cost $117. Now you save $48 on this great three-in-one package!

The Long Weekend: The first Australian movie to be released by Magnetic Video. Peter and Marcia's simple weekend away in the bush turns into an ordeal of horror. And the ending is a shocker (don't watch it alone).

All That Jazz: Bob Fosse's spellbinding film celebrates show business, yet strips it of the glitter and glamour to lay bare the energy, the guts, the pain and the exhilaration. Stars Roy Scheider and Jessica Lange.

When we say movie festival, we mean movie festival. All the greats like **Sound of Music, The Muppet Movie, Alien, M*A*S*H, French Connection, Planet of the Apes.** Plus documentaries, sports, cartoons.

So if you really want your very own movie festival this Christmas, just a little hint for Santa...

Buy your Magnetic Video cassettes from department stores, video specialists and major electrical retailers.

Magnetic Video

A Twentieth Century-Fox Company

Write to Magnetic Video (South Pacific), Northpoint, 100 Miller Street, North Sydney, 2060 for a free full colour comprehensive Magnetic Video catalogue, absolutely obligation free.

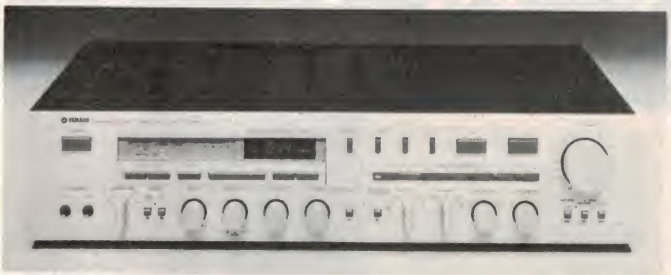
Name

Address

Postcode

MAG039

SIGHT & SOUND news



Good sound and easy operation from Yamaha receiver

The R-2000, Yamaha's new top-of-the-line receiver, gives 100 watts per channel and incorporates many special features to produce natural sound reproduction with automatic convenience operation.

The 'X' power amplifier circuitry gives consistent, efficient power amplification, and overcomes the problem of excessive heat by using a power level switching system. Two levels of supply power, high voltage and low voltage, are delivered to the amp. The circuitry monitors the music signal and switches on the high voltage supply only when it is required to handle high-level music peaks. The 'X' power amp circuitry is also said to feature very low distortion.

The R-2000 contains several preamp features to improve the sound reproduction, including Yamaha's 'Spatial Expander', which allows the listener to create the 'open' impression of live music without the need for extra speakers or amplifiers. There is also a built-in, high performance moving coil head amp, and R-2000 offers three different cartridge loads for optimum compatibility with most available cartridges.

Other preamp features are the 'Auto-Phono Function', which will automatically switch the receiver back to another selected music course at the end of a recorded album, and a continuously variable loudness control. This compensates for human insensitivity to bass and treble frequencies at low volumes by boosting these frequencies at these volumes and suppressing the midrange to avoid noise and distortion.

The R-2000's tuner produces no interference-causing RF noise, unlike many quartz phase-locked loop synthesiser tuners. In addition, the tuning system is said to lock the tuner's frequency extremely accurately onto that of the broadcast station, giving completely distortion-free reception.

Seven FM and seven AM stations may be preset, and tuning level buttons allow the user to choose among all stations or only those with strong signals. Automatic DX/Local switching gives higher receptivity when a weak station is received and broader selectivity with a strong signal, which also provides more accurate and distortion-free reproduction.

The R-2000 comprises several other features too numerous to mention here, and the whole is enclosed in a simulated ebony cabinet with chrome-finished faceplate. The recommended retail price is $1000.

For further information contact the Public Relations Manager, Yamaha/Rose Music, 17-33 Market Street, South Melbourne Vic. 3205. (03)699-2388.

Dick Smith 'Walkie' Stereo

The Dick Smith 'Walkie Stereo' (Cat. No. A-4055) has especially lightweight headphones, making it ideal for joggers, golfers, walkers, etc, who like to listen to their favourite music when they are on the move.

The Walkie Stereo has a tone selector and an auto shut-off mechanism to protect the tape, plus two headphone sockets so that friends can share the music. There is even a 'Talk' button that enables communication between the two people wearing the headphones!

The Walkie Stereo cassette player costs $99 and is available from Dick Smith stores.

Four-hour VHS cassette from National

Due to demand by industry and government departments, National has developed a four-hour VHS video cassette (said to be 'problem-free') — the longest VHS video cassette now available throughout the world.

According to the Australian distributors, the Electronics Division of GEC, quality has not been lost with the increase in playing time, and the tape is the same standard thickness as that used on other quality National video cassettes.

The extra 70 m of tape have been accommodated inside the standard-size cassette cartridge by reducing the size of the core round which the tape is wound. All other internal mechanisms remain the same.

It is claimed that the extended-length video tape (designated the NBE-240) will not foul like some long-playing audio tapes, and that it is subject to less wear and tear during continuous use.

It is expected that the four-hour tape would be used in security and surveillance or time lapse monitoring, as well as allowing more reference material to be stored in one place.

The NBE-240 has only just been released in Australia, and is available from the Electronics Division of GEC Australia Ltd. For further information contact David Rose on (02)212-5488.

New MD for Sharp Australia

Mr. Hiroshi Kawai has been appointed managing director of Sharp Corporation, Australia.

A veteran of the Japanese and American electronics boom, Mr. Kawai has played a leading role in the company's export operations for the past 22 years. He was a member of the second sales team to be sent by Sharp to the United States in 1960, and was largely responsible for the company's first contract to produce television sets for the US market. More recently he was Executive Vice-President of Sharp's business equipment division in America.

Before coming to Australia Mr. Kawai spent seven years at Sharp in Japan, where he headed the world-wide export division for home appliance products, including the microwave oven market, which Sharp leads in Australia.

Fisher products for Australia

Following Sanyo's acquisition of the Fisher Corporation of the USA in 1977, it has been announced that Sanyo will market Fisher-branded products in Australia, to be available from early 1982.

It is envisaged that Fisher products will cater for 'up-market' tastes in hi-fi and home recording, and will provide a wide range of innovative products. Marketing and service functions for Fisher will be handled by Sanyo Australia through its existing staff and organisation.

Three 'up-market' portable tape recorders with recommended retail prices starting at $399 will be released in January, followed in March by a range of sophisticated hi-fi systems with prices starting around $1500.

On the home video scene, Sanyo has adopted a corporate philosophy of non-alignment to any one video format in tape or disc. It will manufacture players for all three disc formats, and in addition to its factory in Osaka manufacturing Beta system VCRs has established a new factory in Tokyo to manufacture VHS system VCRs. This new factory is already supplying VHS system VCRs to the USA under the Fisher brand; Beta system VCRs will carry the Sanyo brand.

Sanyo is also expanding its Beta system range to four models, including a new portable, commencing this Christmas; the first Fisher-branded VCRs will be available around the middle of 1982.

In the long term the Fisher range will be extended to other product areas.

For further information contact Mr. Mike Hart, Australian Sales Manager, Sanyo Australia Pty Ltd, 225 Miller St, North Sydney NSW 2060. (02)436-1122.

'The quality remains after the price is forgotten.'

Henry Royce, founder of Rolls-Royce, 1906.

ZEROSTAT
ANTI-STATIC PISTOL

The new red Zerostat Pistol is the latest version of a leader in it's field. The simplest way to remove static and it's associated symptons. Needs no refills, batteries or power supply and neutralises static charges in seconds. Lasts for at least 50,000 operations. **$24.95.**

New discwasher®
DISCKIT

Combines the Zerostat Anti-static pistol, Discwasher D-4 Record Cleaning System and Discwasher SC-2 stylus cleaner in a handsome walnut storage tray with smoked perspex dust cover at a significant cost saving over the individual components. **$69. Save 22%. Discorganiser,** the walnut tray and the perspex lid are available separately for just **$25.**

New discwasher®
D4 RECORD CLEANING SYSTEM

New formula D-4 fluid removes dust, dirt, even fingermarks, whilst protecting the vinyl record surface. Walnut mounted D-4 fabric pad has extra soft directional fibres to absorb fluid and contamination, leaving record surface entirely free of contamination or residue of any kind. DC-1 pad cleaner keeps the fabric in good condition for maximum efficiency. **$24.95.**

Available now from hi-fi and record stores.

from **ZEROSTAT**
and
discwasher®
Sole Australian Distributors

arena DISTRIBUTORS

642 Albany Highway, Victoria Park, W.A. 6100.
Ph: (09) 361 5422 Telex: 93299

New discwasher®
SC-2 STYLUS CLEANER

SC-2 Stylus Cleaner fluid is formulated to disperse not only harmful grit, but also the very vinyl additives which D-4 fluid protects and which can clog stylii. SC-2 brush, with bristles of a calculated density and texture, removes dirt without damage to delicate stylus cantilevers. Reverse of brush is a magnifying mirror for easy stylus inspection. **$13.95.**

NEW DOLBY C SYSTEM JUDGED SUPERIOR

DOLBY B•C NR

by GEOFF MATTHEWS

There has never been much doubt that compact cassette decks have been the most exciting thing to happen to hi-fi systems since hi-fi was first invented.

However there has always been a question of which noise reduction system is the best one to own — the Dolby system or one of the more recently devised American, Japanese or European noise reduction systems.

Recently though, the question seems to have been laid to rest.

In the past few months, the Dolby system has emerged the clear choice by just about every important maker of cassette decks throughout the world.

DOLBY B

Dolby B noise reduction was a key factor in launching the cassette as a viable hi-fi medium. Dolby B quickly became the standard noise reduction system amongst consumers with three major factors contributing to its success: a decisive 10 dB improvement in high frequency S/N; minimal audible side effects; and, fairly inexpensive circuitry. Since 1968 when Dolby B was introduced, the phonograph record has become much better with a movement towards direct cut disks, digital mastering and half speed cutting. Improvement in cassette heads, electronics and tapes have broken the 20 kHz barrier and cassette recorders with response to 25 kHz have become a reality. Taken together, these factors have created a demand for a noise reduction system with greater capability than Dolby B, which reduces tape hiss and other high frequency noise generated during the tape recording process by a maximum of 10 dB.

LINEAR COMPANDERS

While Dolby is the acknowledged leader in the field of noise reduction for consumer audio products, the Dolby system is hardly alone any longer. Several noise reduction systems have been devised by American, Japanese and European companies, and simple linear companders that offer greater dynamic range than Dolby B are available. However they have unfortunate side effects — audible "pumping" and "breathing". In short, they can be heard "working" and this is unacceptable. As a rule of thumb, the greater the noise reduction, the greater the possibility of audible colouration. In fact the success of Dolby B is due largely to its adroit trade-off between S/N improvement and audible side effects.

DOLBY C

Since Dolby Laboratories announced and demonstrated their newest noise reduction technology which they called Dolby C, just about every important maker of cassette decks has introduced one or more models which incorporates the newest of Dolby's consumer type noise reduction systems.

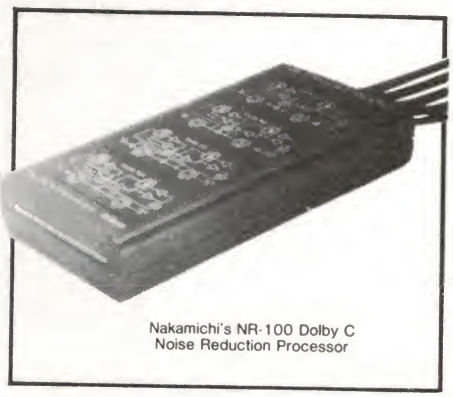
The new Dolby C noise reduction system offers up to 20 dB of noise reduction at high frequencies and begins operating at a lower frequency point in the spectrum than did Dolby B. However, Dolby C is not "across the board" circuitry that will be used by manufacturers in all of their cassette deck models from most expensive to least costly. Dolby C, while usable by Dolby licensees without having to pay any additional royalty, costs approximately 2½ times as much to incorporate into a deck than does Dolby B. Furthermore, as some manufacturers are finding out, the new noise reduction system only works best when it is used in high quality decks which have reasonably uniform frequency response capabilities to begin with.

INCREASED DYNAMIC RANGE

Noise reduction and increased dynamic range are closely related. When the noise threshold decreases, greater dynamic range can be stored by a music storage medium such as disk or tape. Dolby has always stressed the noise reduction qualities of their systems but points out that with Dolby B, they can approach dynamic range capabilities of 80 dB on a properly designed cassette deck. Dolby C affords substantially greater dynamic range without increased colouration.

COMPATIBILITY

Dolby suggests that new cassette recordings made using the Dolby C process will sound reasonably good when played back on decks which are equipped only with Dolby B decoding circuitry. Whilst shunning the word "compatibility", they have maintained that Dolby C recordings played back with no decoding whatever will be "listenable" to non-critical ears.



Nakamichi's NR-100 Dolby C Noise Reduction Processor

On the other hand, makers of other noise reduction systems make no such claims admitting that a recording made using one of them cannot be played back properly using equipment that contains a decoder of a competing system. In that sense, none of the systems are compatible with either their competing systems or with play back systems not equipped with any noise reduction system.

DOLBY RANKED NUMBER ONE

In offering 20 dB of noise reduction, substantially greater dynamic range without increased colouration and "compatibility", Dolby has taken another major step forward in improving the compact cassette as a hi-fi medium. And its choice by major cassette deck manufacturers clearly indicates that the experts believe that the Dolby system offers better technology, better features and better hi-fi.

SIGHT & SOUND news

New National Panasonic low light cameras

National Panasonic have released a new series of low light level cameras onto the Australian market which are specifically designed for security, surveillance and other specialised closed circuit applications.

Particular use is being made of the camera in situations where the use of expensive lighting is prohibitive.

Apart from the obvious security applications, such as defence installations, other areas of use include industrial instrumentation application, mines and tunnels, on wharves at night, various medical laboratory procedures involving TV microscopy, engineering laboratory procedures requiring a minimum of light, and also in the study of animals and their nocturnal activities. The camera has been used in the study of insects and their night flights.

The WV-1900 and its 24 Vac low voltage counterpart, the WV-1904, are lunar light cameras which provide usable video pictures under moonlight conditions.

The secret to the success of the camera is the sensitive Newvicon tube with fibre optics, which incorporates an image intensifier to ensure high performance in limited light conditions. High-quality integrated circuitry is also used to create clear pictures in adverse conditions.

Minimum illumination for the moonlight camera is only 3×10^{-4} footcandles for a usable picture and 3×10^{-3} footcandles for recommended illumination.

These cameras, along with other CCTV products in the National Panasonic range, are available through the Electronics Division of GEC. For further information contact David Rose on (02)212-5488.

In-car sound from Kenwood

Kenwood Hi-Fi recently introduced a matching range of hi-fi stereo components intended for mounting on the dashboard of a car.

The range includes the KTC-767 AM/FM stereo tuner (rrp $345), whose features include an automatic noise reduction circuit which monitors FM signal quality and automatically switches to a sequence of alternative reception modes to provide the best available sound, and the Automatic Broadcast Search System, which automatically seeks a stronger station when any AM or FM signal becomes too weak.

The KXC-757 is an auto-reverse cassette deck with Dolby, and has an rrp of $325. The same size as the tuner, it incorporates many features, including a 'cassette standby', whereby a cassette may be cued up indefinitely — without damage to tape or machine — and programmed to activate automatically when radio reception falls below acceptable limits.

Equalisation functions are provided by the KGC-747 graphic equaliser (rrp $185), also the same dimensions as the tuner and cassette player. An alternative is the KGC-737 graphic equaliser/amplifier (at $245), with the same measurements and low-level equaliser circuitry as the KGC-747, but with four built-in power amplifiers that provide five watts of drive to each of the front speaker systems and 15 watts to those in the rear.

Two power amplifiers are available to complement the equalisers: the KAC-801 (rrp $245) and the KAC-727 (rrp $185). These amps are small enough to be mounted either in the boot or underneath a seat, and the KAC-801 features a remote control power switch and delivers 50 watts per stereo channel. The KAC-727 delivers 15 watts per channel, and matches the tuner, cassette deck and equalisers in appearance.

Will the videodisc survive?

The much-heralded videodisc is still meeting serious problems, and Europeans are seriously questioning whether it is in its death throes. Both Philips and JVC have postponed its launch in Europe, although Philips attribute their repeated delays in the launching of their product to the inability of their Blackburn plant to manufacture the discs in adequate quantities.

However, many people are asking whether the videodisc can be a viable commercial proposition for the mass consumer market. Can it really provide effective competition to the video cassette recorder? Surely anyone with the necessary cash to spend on equipment will purchase a VCR on which programmes can be recorded off the air and immediately wiped out when not required? Few families will wish to spend their hard-earned cash on two separate items of equipment for home video systems.

The videodisc does have the advantages that it will not wear appreciably, the discs will probably be priced at about half that of a pre-recorded video cassette and one may obtain better quality from a disc. However, who could wish to pay perhaps $100 for his favourite film on videodisc when he can wait for it to appear on television or record it from a rented pre-recorded tape using a VCR?

It has been suggested that the videodisc will survive because of the interest it will arouse in potential commercial users, who can pay relatively high prices for material unobtainable in other forms. However, RCA's experience with a low-priced videodisc system which has been selling in the USA for the best part of a year has been that sales volume is relatively low.

Even Sony has decided to back out of the consumer videodisc market, preferring to concentrate on institutional users such as schools, colleges and private companies. Although the sales volume will be relatively small, it could be profitable.

Many people in Europe feel the videodisc system will become viable only if playing equipment comes onto the market in a very cheap form (perhaps of the order of $200), with discs selling for not more than perhaps $10 each at current price levels. It seems doubtful whether any manufacturer can offer a satisfactory product — or indeed any product — at such prices.

Brian Dance

Anti-feedback amp introduced

Audio Telex Communications, who make the successful DI Series public address amplifiers, recently released a new anti-feedback unit, the AF100, which is primarily designed for use in areas of high feedback or reverberation, such as churches, lecture halls, halls and airports.

The AF100 series features a number of facilities specifically inbuilt to eliminate feedback and poor intelligibility. These include:

- Graphic equaliser with six notch filters
- Compression circuitry, up to 10 dB, switchable on/off
- Limiter with 100% overload capacity, switchable on/off
- Battery-charging circuitry (trickle)
- 100 watts RMS output with a frequency response of 35 Hz to 17.5 kHz
- 240 Vac, 24 Vdc operation.

The AF100 is moderately priced and is said to cost less than many conventional public address amplifiers.

The unit is available from Audio Telex Communications Pty Ltd, P.O. Box 421, Parramatta NSW 2150, (02)633-4344; P.O. Box 468, Mt. Waverley Vic. 3149, (03)277-5311; and P.O. Box 44, West End Qld. 4101, (07)44-6328.

Not Just Speaker Wire

Conventional speaker wire limits the performance of your sound system by decreasing power output, restricting dynamic range, and reducing clarity and definition. You can significantly improve the performance of your audio system by switching from your present speaker wire to Monster Cable.

Constructed of over 500 strands of high purity copper in a unique configuration, Monster Cable is specifically engineered for low resistance, low capacitance, and low inductance. The Results?

Deeper, tighter bass.
Maximum power transfer.
Increased clarity and definition.
Wider dynamic range.

Even low-powered systems show a remarkable improvement. Recommended by leading audio manufacturers, Monster Cable is safe to use with all amplifiers and receivers, regardless of design.

Don't be deceived by imitations. If it doesn't say Monster Cable you're not getting all the performance you paid for.

MONSTER CABLE

DISTRIBUTED BY CONVOY SYDNEY (02) 358 2088

Available from: **N.S.W.**—DUTY FREE TRAVELLERS SUPPLIES Sydney • CAMPBELLTOWN HI FI Campbelltown • LEISURE SOUND City, Parramatta, Artarmon • NEWCASTLE HI FI Newcastle • PITMANS Wagga • RUSSIN ELECTRONICS Ashfield • DAVE RYALL ELECTRONICS Dee Why • SPRINGWOOD HI FI Springwood • TAMWORTH HI FI Tamworth • LEN WALLIS AUDIO Lane Cove • WOOLLAHRA ELECTRONICS Woollahra • WOLLONGONG HI FI Wollongong • EASTERN HI FI Newcastle • **ACT**—DURATONE HI FI Phillip • KINGSTON HI FI Kingston • **VICTORIA**—NATSOUND Melbourne • BOON SOUND Wodonga • EAST COAST AUDIO Albert Park • SOUNDCRAFTSMAN Nth. Caulfield • TIVOLI HI FI Hawthorn • STEVE BENNETT AUDIO Geelong • **QLD.**—DISCO & STEREO SUPPLIES Townsville • GOLD COAST HI FI Southport • HANDO HI FI Toowong • HI FI SALES Redcliffe HIGHWAY SOUND Mt. Isa • REG MILLS STEREO Burunda • STEREO SUPPLIES Brisbane • STEREO WORLD Cairns • **STH. AUST.**—ASLIN HI FI Mt. Gambier • BLACKWOOD SOUND Blackwood • GRENFELL PLAZA HI FI Adelaide • SOUNDCRAFTSMAN Hawthorne • TRACK HI FI Adelaide • **W.A.**—ALBERTS Perth • E. Victoria Park, Balga, Freemantle • THE AUDIO CENTRE West Perth • AUDIO DISTRIBUTORS Mosman Park • JAPAN HI FI Victoria Park • LESLIE LEONARDS HI FI East Perth • NORTH WEST AUDIO Karratha • **TAS.**—BEL CANTO Hobart • UNITED ELECTRONICS Launceston • **N.T.**—RADIO PARTS Darwin.

REACH FOR RALMAR...

DECISION DIRECTORY

H

- **Headphones**
- **Headshells**
- **Heat shrink tubing**
- **Hi-Fi —** Cable; connectors; Fittings; Speakers
- **High speed fuses**
- **Hobby tools**
- **Holders —** Battery; Fuse; Microphone
- **Horns —** P.A.; Siren
- **Hook up wire**

I

- **I.C. Clips**
- **Indoor TV antenna**
- **Indicators**
- **Intercoms**

J

- **Jacks**
- **Jumper wire**

K

- **Kits — Amplifier Module Kits** Cassette Care Kits; Record Care Kits

RALMAR®

JUST PART OF THE RANGE!
AVAILABLE AT SELECTED STORES EVERYWHERE!

TRADE ENQUIRIES...
N.S.W. Ralmar Agencies P/Ltd (02) 439 6566
Vic. Ralmar Agencies P/Ltd (03) 267 3028
S.A. Charles Harwood P/Ltd (07) 264 1118
QLD. Olbertz International P/Ltd (07) 261 1513
W.A. Bruce Ingram & Assoc. P/Ltd (09) 381 7777
TAS. George Harvey P/Ltd (003) 331 6533

RAL2/81

MASTERS OF THE STUDIO.

There's as much magic in the mixing board as there is in the keyboard.

That's why, when we award the Ampex Golden Reel, it goes to both the recording artist *and* the recording studio. Together they provide the magic that turns a reel of recording tape into an outstanding creative achievement.

The Ampex Golden Reel Award honours those achievements that were mastered on Ampex professional recording tape. They've earned a place in the ranks of the world's most successful recorded albums and singles.

Along with the Award, we also present $1,000 to a charitable organisation.

Since we started the Golden Reel Awards three years ago, there have been over 200 recipients worldwide, including six in Australia. More than $200,000 has been donated on their behalf.

Congratulations to all of them. The masters on both sides of the microphone.

AMPEX

Ampex Australia Pty Ltd, 65 Waterloo Road, North Ryde, N.S.W. 2113.
Ampex Australia Pty Ltd, 21 Terra-Cotta Drive, Blackburn, Victoria 3130.

AMP 014

Inside Quad's latest electrostatic loudspeaker

No new loudspeaker development has probably been heralded by more rumour, speculation and comment that Quad's new electrostatic model. Their 'original' electrostatic loudspeaker has been in continuous production for more than 25 years and has enjoyed a reputation as a 'standard' by which many other speakers are judged. Let's see what the 'new' one is all about . . .

Brian Dance

IT IS OVER a quarter of a century since the Quad electrostatic loudspeaker was introduced as a new approach to high-fidelity sound reproduction. When it first became available, many people considered it to be the ideal loudspeaker for domestic use, and over a prolonged period it has been widely adopted as a standard of reference by engineers in the recording and broadcasting fields. It is remarkable that this loudspeaker has been able to keep such a reputation for so long in spite of intensive developmental work on loudspeaker design by many manufacturers. Can you think of any other specific product in the high-fidelity field which has been a leader for so long?

This same Quad electrostatic loudspeaker will continue to be produced by the Acoustical Manufacturing Company Ltd of Huntingdon, Cambridgeshire, England, but this manufacturer is now introducing a new and improved successor to its original design. The new electrostatic loudspeaker is designated the Quad ESL-63 and is currently priced about 65% higher than the earlier model. The development of the new model has taken many years — indeed, there are no prizes for guessing what the 63 in its new model number signifies!

Electrostatics

The basic idea of an electrostatic loudspeaker is very attractive, since the moving diaphragm can be driven in a controlled manner over its whole surface and can therefore be very light and flexible. Indeed, work on the electrostatic loudspeaker was carried out well before Rice and Kellogg invented the moving coil loudspeaker; the latter is driven by a coil fixed to a small region of the cone and therefore the cone must be of a fairly rigid and heavy material. Such a heavy moving cone stores much energy, and problems arise because it is necessary to mount a moving coil loudspeaker in some form of a cabinet to achieve satisfactory energy coupling at low frequencies to the air, and the cabinet introduces undesirable resonances of its own in addition to the speaker resonances.

One may therefore wonder why the electrostatic loudspeaker has not been much more widely used in the past instead of the moving coil. In order to obtain adequate sensitivity, the gap in which the light diaphragm moves must be kept small (since the force between electrostatic charges decreases as the inverse square of the distance between them) and this tends to restrict its use to the higher frequencies. Indeed, many electrostatic high-frequency 'tweeter' units have been produced for use with moving coil bass and mid-range speakers.

Another problem is the inherent non-linearity of the simple type of electrostatic construction, although this difficulty can be removed by suitable constructional techniques. In addition, an electrostatic loudspeaker offers what

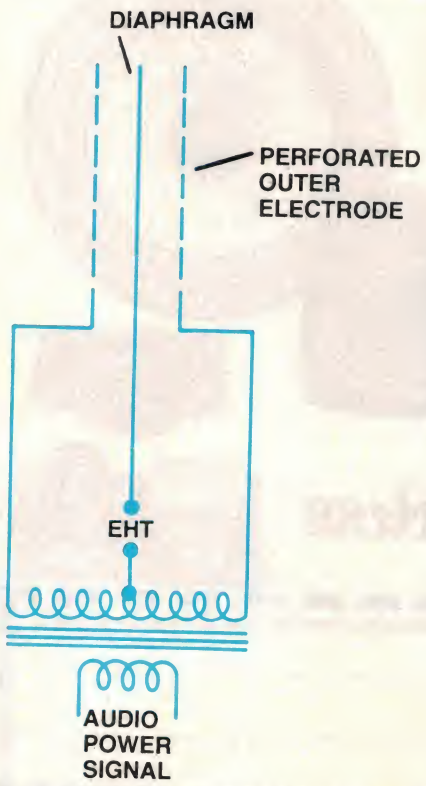


Figure 1. **The basic electrostatic speaker push-pull drive system.**

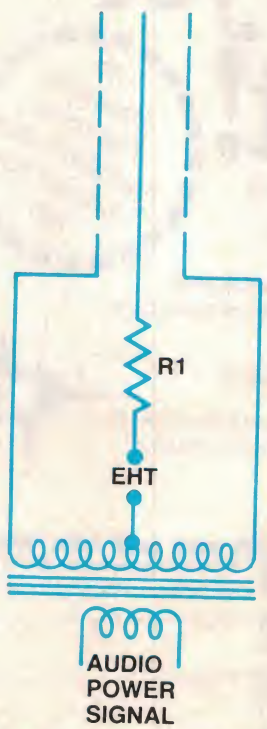
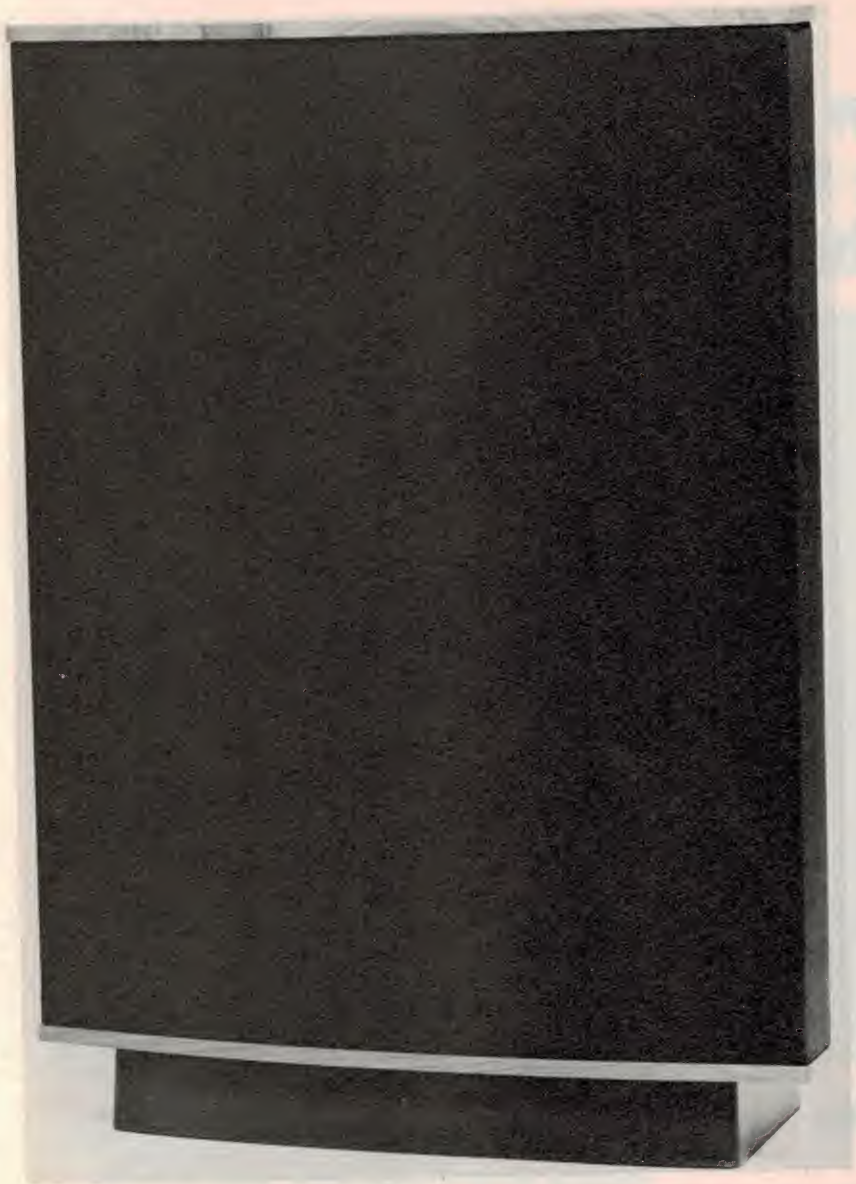


Figure 2. **Linear electrostatic speaker drive system with a constant charge on the diaphragm.**



is essentially a capacitive load to the power amplifier feeding it and this may give rise to matching problems.

The basic form of an electrostatic loudspeaker can be represented as in Figure 1, in which a very light diaphragm moves between two electrodes in a push-pull system. A high polarising voltage is applied between the moving diaphragm and the two outer electrodes, while the audio signal is coupled by means of a step-up transformer so that it appears in anti-phase between the two outer electrodes. The diaphragm is attracted by electrostatic forces, but unfortunately this attraction is non-linear.

In order to produce a loudspeaker with a linear response, one needs to make the charge on the diaphragm constant and independent of its position relative to the other two electrodes. This can be accomplished by inserting a large resistor, R1 in Figure 2, between the high voltage polarising supply and the diaphragm, so that the time-constant formed by this resistor and the electrode capacitance is large when compared with the period of the audio frequency signals. The force on the diaphragm at any instant is now proportional to the instantaneous value of the signal voltage across the transformer secondary winding.

The two outer electrodes will normally be stationary grids which can allow air to pass easily through them. The centre electrode is a piece of stretched membrane which is sufficiently light and unrestrained that if it is placed in a sound wave, it will vibrate to follow the motion of the air molecules without affecting their motion appreciably. In other words the speaker system is acoustically transparent. Such a loudspeaker can provide a response which is level at frequencies of up to at least 20 kHz, after which the effective mass of the diaphragm may reduce the output power by some 6 dB per octave. At low frequencies the response is limited by the stiffness of the diaphragm required for stable operation, but the response can be extended to lower frequencies by increasing the electrode spacing and reducing the diaphragm stiffness; however, this reduces the acoustic output for a given input signal power and a higher polarising voltage is needed.

The original Quad electrostatic loudspeaker was designed to provide the full audible frequency range from a unit which should be placed a little way from any obstructions at either the front or the rear. Its efficiency (sound output level for a given signal input power) is somewhat less than that of many moving coil loudspeakers, and a power amplifier with a 25 W output is required. Like all electrostatic loudspeakers, a mains power supply is required for generating the polarising voltage. One of the main attractions is the absence of any sound colouration from cabinet resonances.

Sound dispersion

The main way in which the new Quad ESL-63 differs from other types of loudspeaker (both moving coil and electrostatic designs) is the technique by which a satisfactory sound dispersion pattern is obtained over the full audible frequency range without the use of the conventional multiple drive units, with or without crossover systems.

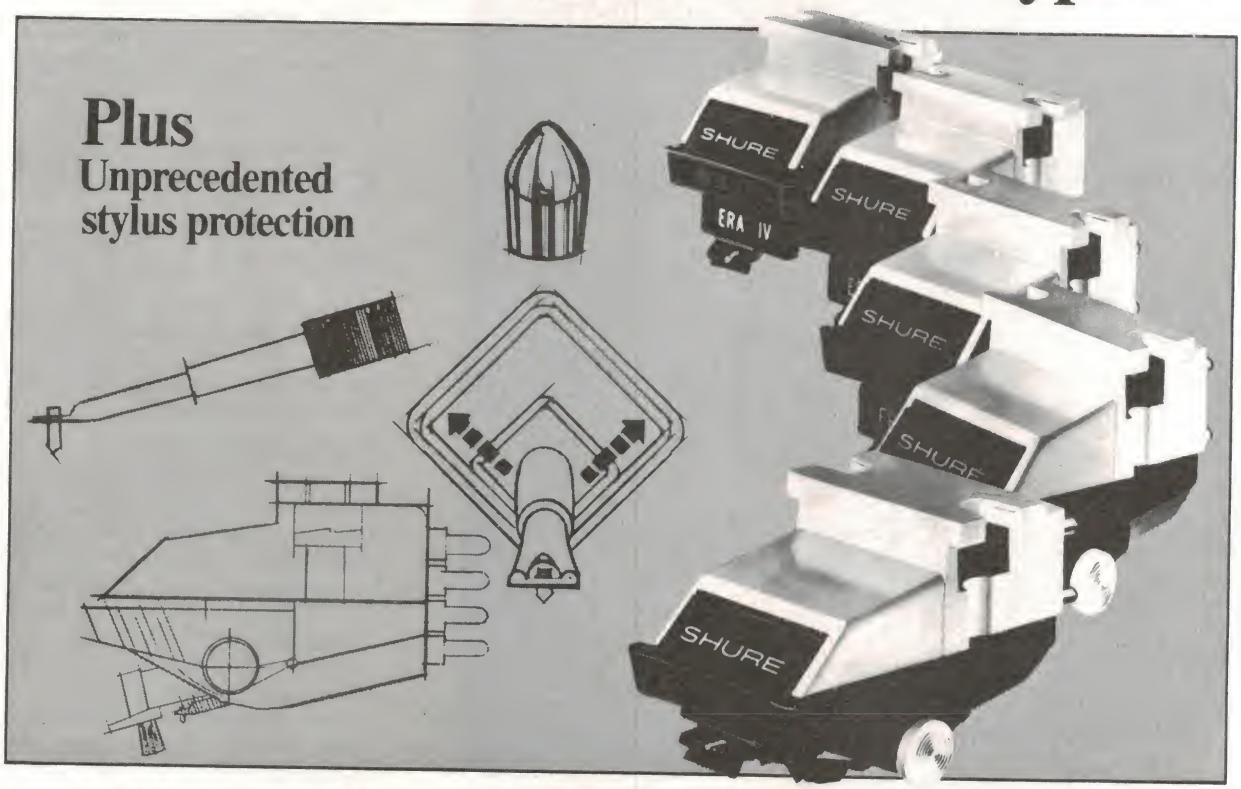
Let us imagine a theoretically ideal point source of sound, A in Figure 3, radiating sound pressure waves to a listener at B. The waves are concentric spheres like the two-dimensional waves formed on the surface of water after a stone has been thrown into the water.

If one considers the place CD a little way in front of the source A at right angles to the direction of propagation of the sound wave, the air molecules will be moving in the direction shown to generate the concentric waves shown on the right hand side of this plane. In Figure 4 this imaginary plane is replaced by a very light membrane of an electrostatic loudspeaker, and the original sound source is removed from behind the plane. If the membrane moves in the same way as the air molecules of Figure 3, the resulting waves produced should be heard by the listener so that they are quite indistinguishable from the original sound source A of Figure 3.

The listener therefore forms in his mind a virtual image of the source of sound at E in exactly the same way that a virtual image is formed in a plane mirror by light waves, except that the mirror is not the source of energy.

The Quad ESL-63 operates on this ▶

fact:
five new Shure Cartridges feature the technological breakthroughs of the V15 Type IV



the M97 Era IV Series phono cartridges

Shure has written a new chapter in the history of affordable hi-fi by making the space-age technological breakthroughs of the incomparable V15 Type IV available in a complete line of high-performance, moderately-priced cartridges: the M97 Era IV Series Phono Cartridges, available with five different interchangeable stylus configurations to fit every system and every budget.

The critically acclaimed V15 Type IV is the cartridge that astonished audiophiles with such vanguard features as the Dynamic Stabilizer — which simultaneously overcomes record-warp caused problems, provides electrostatic neutralization of the record surface, and effectively removes dust and lint from the record — and, the unique telescoped stylus assembly which results in lower effective stylus mass and dramatically improves trackability.

Each of these features . . . and more . . . has been incorporated in the five cartridges in the M97 Series — there is even an M97 cartridge that offers the low distortion Hyperelliptical stylus!

What's more, every M97 cartridge features a unique lateral deflection assembly, called the SIDE-GUARD, which responds to side thrusts on the stylus by withdrawing the entire stylus shank and tip safely into the stylus housing before it can bend.

For Technical service and advice, contact the Audio Engineers representative at the office in your State.

® SHURE ®

or send this coupon to:

AUDIO ENGINEERS 342 Kent Street
SYDNEY, N.S.W. 2000 Tel: 29-6731

Please send me your 'free' brochure on Shure Cartridges. (PLEASE PRINT NAME AND ADDRESS)

NAME: _____

ADDRESS: _____

_____

Postcode: _____ ET48I

AUDIO ENGINEERS PTY. LTD.
342 Kent Street
SYDNEY, N.S.W. 2000

NOMIS ELECTRONICS P/L
689 South Road
BLACK FOREST, S.A. 5035

AUDIO ENGINEERS (Qld)
51A Castlemaine Street
MILTON, Qld. 4064

AUDIO ENGINEERS (Vic.)
2A Hill Street
THORNBURY, Vic. 3071

ATHOL M. HILL P/L
33 Wittenoom Street
EAST PERTH, W.A. 6000

AE161

principle. It consists of a diaphragm (which is very light and electrically polarised) suspended between two sets of rigid, acoustically transparent, concentric annular electrodes. These electrodes, which spread the sound pressure pattern across the diaphragm, can be seen in Figure 5. Signals are fed to the electrodes via sequential delay lines so that the diaphragm produces a sound pressure pattern which is an exact replica of that from an ideal source placed about 300 mm behind the plane of the diaphragm.

In order that the system will produce such a sound pressure pattern, the membrane must vibrate in the form of the annularly expanding rings, the amplitude falling with distance from the centre. A radial delay line system incorporating the required attenuation of the form shown in Figure 6 is used in the ESL-63 to produce the required signals for the membrane. In practice the design is complicated by the fact that any loudspeaker must have a finite area, and compensation must be introduced for the interference waves which would otherwise be generated at the edge of the loudspeaker; this can be done by using a suitable design of the lossy delay line.

The Quad ESL-63 is stated to be a totally homogeneous source of sound, phase true and very aperiodic, with a frequency response both on and off axis which is quite free from the irregularities which are inevitable in any multi-way loudspeaker system.

The designer has complete control over the directivity of the loudspeaker, and the mean spherical radiated energy is tapered smoothly at the higher frequencies. The Quad ESL-63 acts as a dipole source with a figure-of-eight dispersion pattern, and has been known by its development engineers as FRED — Full Range Electrostatic Doublet! *(We used to know FRED as a 'Frequently Ridiculous Electronic Device', so that's a new one ... Ed.).*

Such a dipole source has important advantages both in connection with the placement of the loudspeaker in a room and with stereo perception. There is no radiation in the plane of the diaphragm, so it does not excite modes of room vibration which lie in this plane. In practice, the loudspeakers are normally placed at an angle to the horizontal axes of the listening room and excitation of both horizontal axial modes is 3 dB less than with an omnidirectional sound source, while discrimination is imposed against vertical modes.

The ratio of direct-to-reflected sound is much greater with a dipole source than with omnidirectional sources, so the localisation of the stereo image is much improved.

Amplifier requirements

The impedance of the Quad ESL-63 is nominally 8 ohms, predominantly resistive, thus presenting no problems at all to an amplifier. However, it is vitally important to note that amplifiers which do not incorporate short-circuit protection should not be employed with this loudspeaker. The amplifier should have an output capability of 40 V peak (corresponding to 200 W peak or 100 W mean into 8 ohms). Amplifiers with output capabilities of up to 55 V peak (190 W into 8 ohms) can be used, but there is no advantage in doing so.

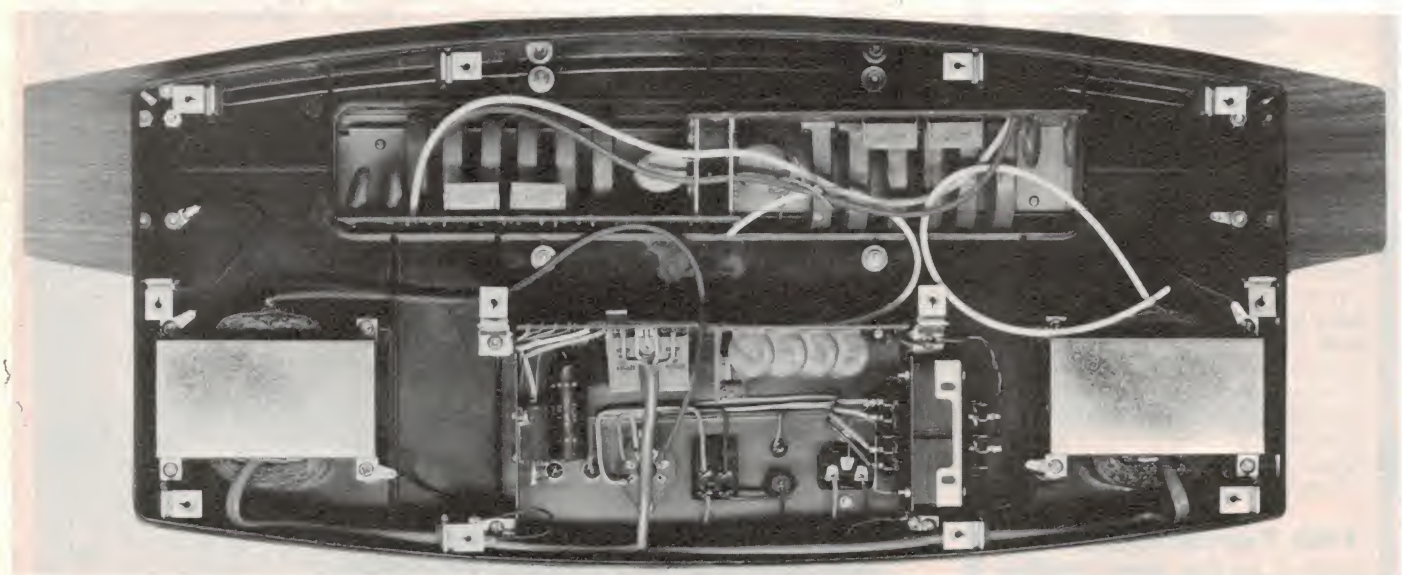
Two protection circuits are fitted into the ESL-63. One of these limits the maximum input voltage which is fed into the loudspeaker; the other detects fault conditions and instantaneously shorts the signal being fed into the loudspeaker — hence the need for an amplifier with short circuit protection. It is impossible to damage the loudspeaker element itself, but the input voltage limiter has a limited thermal capacity and persistent overdrive will overheat this section of the equipment.

The dimensions of the ESL-63 are: height 925 mm, width 660 mm and depth 270 mm, including the 150 mm-deep base which contains all the electronics. It is quite heavy, the net and gross weights being 18.7 kg and 23 kg respectively. It requires a mains supply of either 200/240 V or 100/120 V at 50 to 60 Hz at 5 VA.

The earlier Quad electrostatic loudspeaker could be confused with a room heater with its open-mesh metal grille, but the ESL-63 is a completely re-styled version which many people feel is more suitable for a domestic living room both in appearance and in the convenience brought about by its reduced width.

For the technically minded reader, the maximum output is 2 N/m^2 at 2 m from the loudspeaker on its axis. The bandwidth referred to the −6 dB limit on its axis at low levels is 35 Hz to over 20 kHz. The sensitivity is 86 dB for a 2.83 V RMS input (1.5 μbar per volt referred to 1M). ●

Australian availability:
The Acoustical Manufacturing Co. of Huntingdon, England, have informed Brian Dance that the address of their Australian Distributor is:
Audioson International Pty Ltd
P.O. Box 361
Brookvale
NSW 2100
The new ESL-63 is expected to be available from this supplier by about early 1982.



View underneath the base of the ESL-63, showing the driving and delay line components.

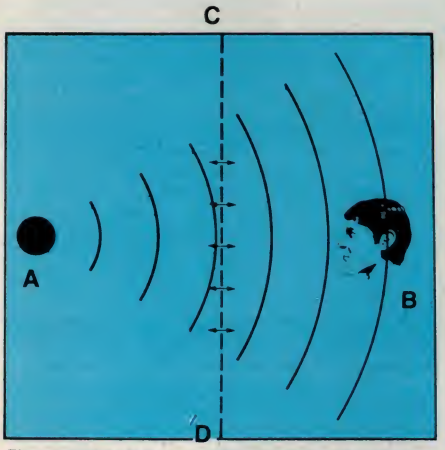


Figure 3. The listener at B hears sounds from the source after it passes through the plane C-D.

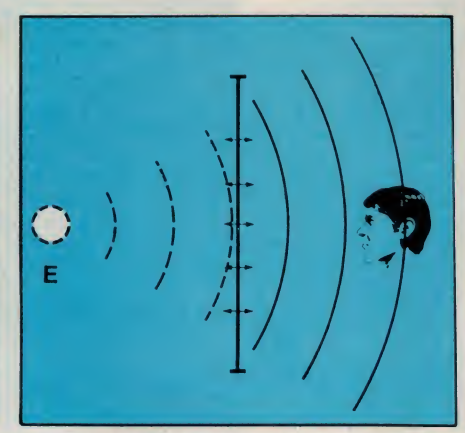


Figure 4. A diaphragm can generate waves identical to those from the virtual source at E.

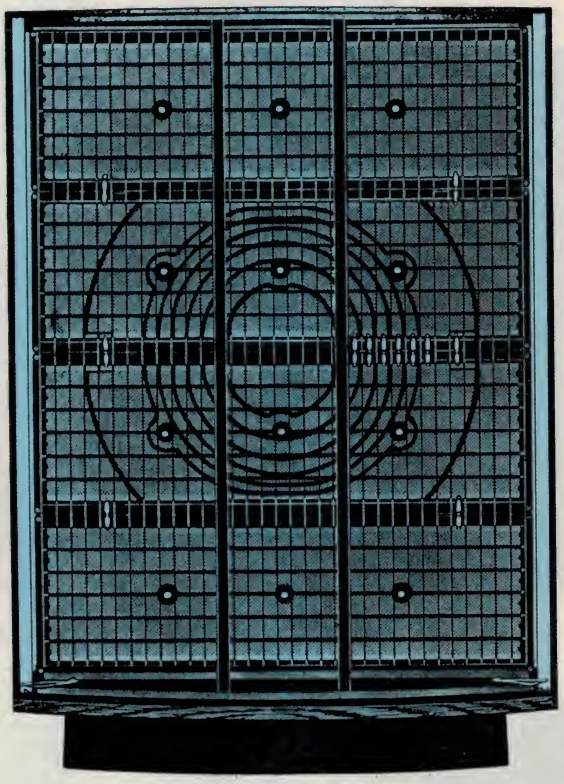


Figure 5. The Quad ESL-63 with the grille cloth removed to show the concentric annular electrodes.

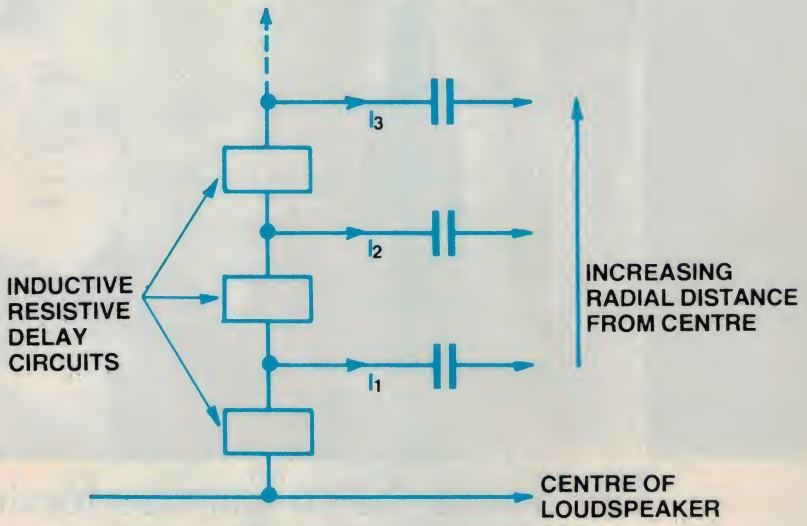


Figure 6. The form of the delay line used to supply the annular electrodes.

It takes time and a great sense...

of perfection to make a wine...

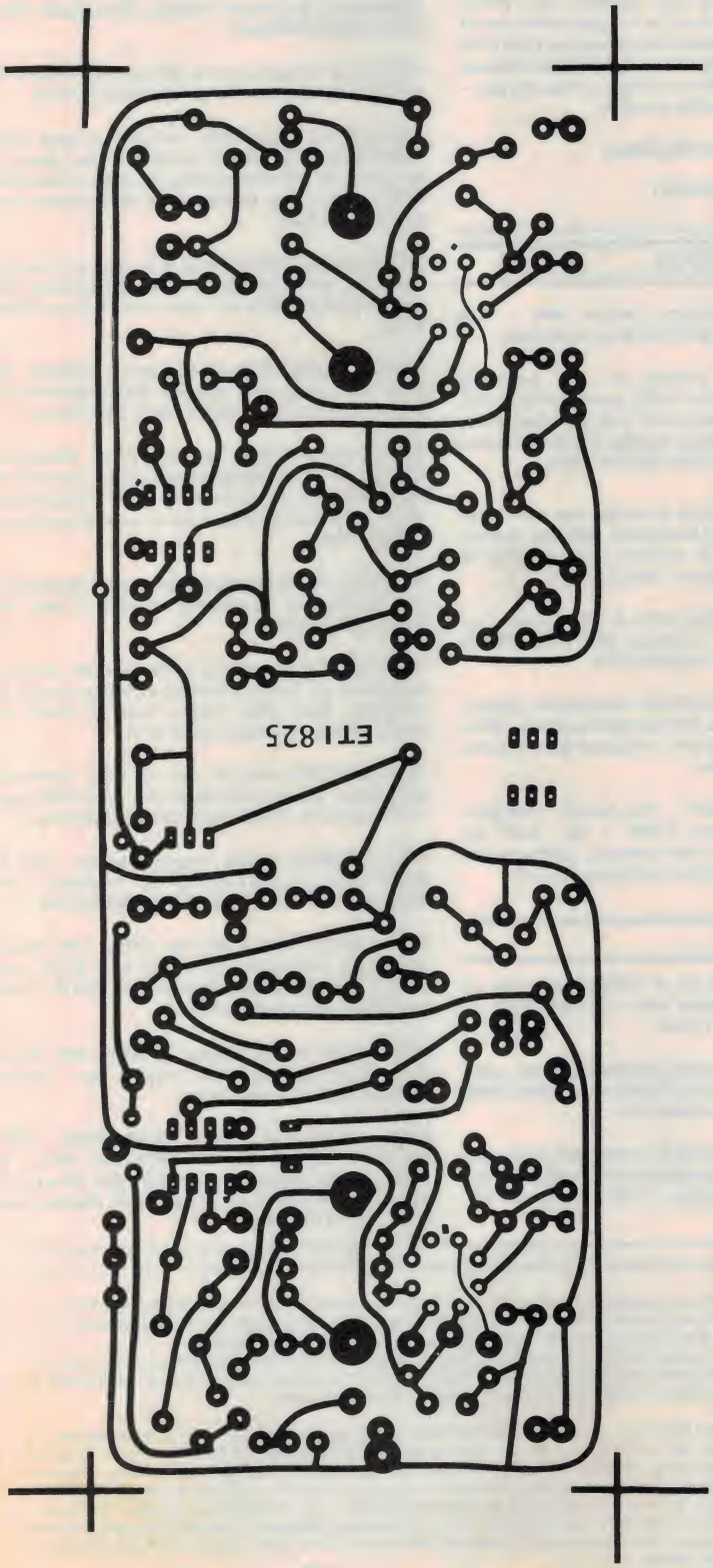
which is worthy of bearing...

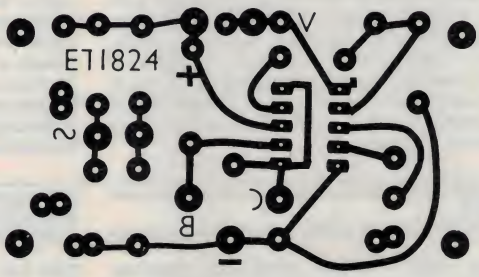
the name McWilliam's.

At last McWilliam's...

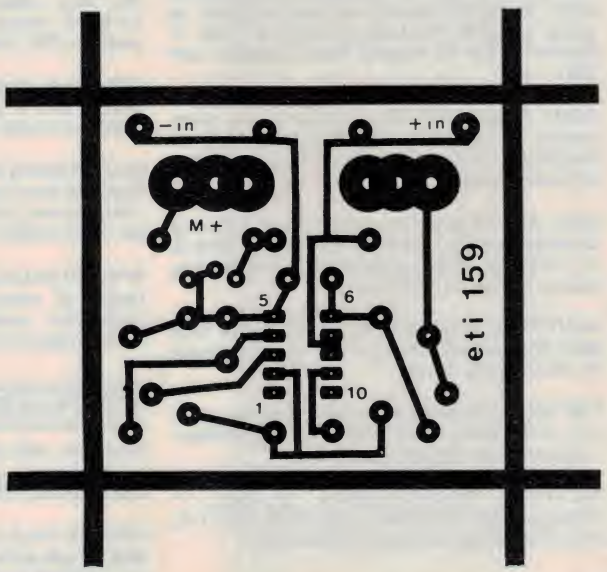
Bin Seventy Seven Traminer Riesling is ready.

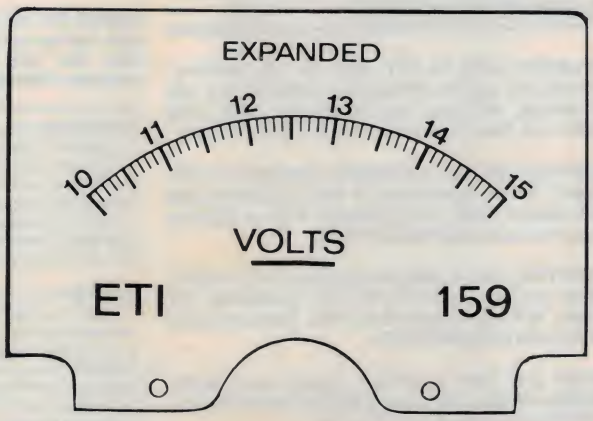
AB972/80 MC1115





Instructions on how to make your own pc boards using the Scotchcal method and exposing through this page may be found on page 159 of the June '81 issue.





MINI-MART

Where readers can advertise — For Sale/Wanted/Swap/Join.

● We'll publish up to 24 words (maximum) totally free of charge for you, your club or your association. Copy **must** be with us by the 1st of the month preceding the month of issue. Please — **please** — print or type adverts clearly, otherwise it may not turn out as you intended! Every effort will be made to publish all adverts received; however, no responsibility for so doing is accepted or implied. Private adverts only will be accepted. We reserve the right to refuse adverts considered unsuitable.

● **Conditions:** Name and address plus phone number (if required) must be included within the 24 words. Reasonable abbreviations, such as 25 W RMS or 240 Vac, count as one word. Adverts must relate to electronics, audio, communications, computing etc — general adverts cannot be accepted.
Send your advert to:
ETI Mini-Mart, Modern Magazines
15 Boundary St,
Rushcutters Bay NSW 2011

AUDIO

SANSUI AU417 DP/DC integrated amplifier, superb specifications, dc-200 kHz, 70 W RMS/ch (reviewed 115 W RMS), 12 months old, mint condition, sacrifice $300 ono. (02)869-1840.

AUSTRALIAN TAPE RECORDING CLUB: Make friends all over Australia through the hobby of tape recording. For information about our club, write to Bill Skillman, P.O. Box 147, Kogarah 2217.

FOR SALE: CLEF TS-88 electronic piano (partly built). 4-channel mixer & 10 watt amplifier, all going at $450 ono. (062)47-3096, or write P. Weckardt, B.8 F4 Allawah Flats, Braddon ACT 2601.

QUAD ELECTROSTATIC speakers, two pairs, perfect condition, bargain $1950 (repiacement cost $5100). (07)225-6474, 225-7128, bus. hrs. Ask for Dave Francis.

SELL: Akai GX-620 RTR t/deck as new, $375 ono. Connoisseur BD-2A t/table with Empire 2000 E/111 cartridge, $125 ono. Geoff Willson, 15 Hirt Ave, Murray Bridge SA. (085)32-4597.

WANTED TO BUY: Sony TC377 reel to reel tape deck. Price and condition to Ray Ivins, 23 Jindivick St. Jindaiee Qld. 4074.

FOR SALE OR SWAP: Sileron BD turntable, lustre arm, mounted in wood cabinet, good condition. 1/9 Scenery St, Gladstone Qld. 4680.

SPEAKERS: ETI-4000 woofers, 12", $135; 7" midrange, $30; KEF B139, $180; B200, $85; T15, $40; STC, $30 per pair, new. (03)470-3171.

COMMUNICATIONS

WANTED: MOD 15 TTY. Must be fully working. Handbook and/or information required but not essential. Will pay any reasonable price. (02) 669-1302, Mon-Thur, after 700 pm, ask for Simon.

WANTED: HF SSB transceiver, frequency coverage 2-15 MHz. Operate on 12 V dc. Suitable to use on marine band. Any condition. Price & particulars, phone Adrian, (004)24-1006.

WANTED: Circuit diagram and any other information on the Gemtronix GTX-36 23-channel CB radio. Will pay reasonable price. Contact David Wilkinson on (03)469-3171.

ICOM 22S, mint condition, hardly used, $270. Mobile aerials, $30. Sanwa EM 300 electrotester, $50. Phone George, (03)687-6778.

MISCELLANEOUS

FOR SALE: Full rollcage, Datsun 1600 – cost $310, sell $195. (047)39-1337 after 4 pm daily.

WANTED: Service manual for JVC 4-channel equipment. Tape deck, 1400U, amplifier MCA-7VE, CD4-disc demodulator 4DD5. Will photostat or pay for photostats. Contact Michael Neep, 17 Fraser St, Launceston Tas. 7250. (003)31-5454.

SELL: Memorex teletype terminal, box new parts inc. fans, electros, heatsinks, diecast boxes, 4 x 6CA7 valves, suit micros. Cheap offers or swap for DEC VDU. Norm, (03)534-1192.

FOR SALE: Musicolour Mark 3 with 6 lamps on boards and all 240 V cabling, $80. Also ETI-505 hi-power strobe, $20. (03)584-9012.

ELECTRONICS MAGAZINES: Electronics Today, Practical Electronics, Electronics Australia, 1970-1981. Approx. 170, lot $50. 19 Garner St, Dromana Vic. 3936. (059)87-1244.

SPECTRUM ANALYSER – TGL SA102, 1-500 MHz range, all solid-state. $1650 + tax. Ideal for transmitter, receiver maintenance, performance testing. (08)271-5412 (bh); (08)381-7419 (ah).

COMPUTERS

WANTED: MEK 6800 D2 or MEK 6802 D5 kit, in working order complete with manuals. Built or unassembled. (09)367-3404.

PRIVATE SALE: Memorex keyboard/printer, suitable for use with micros, RS232 compatible, $700 ono. (07)280-2148, business hrs.

GAMES for HP calculators. 10 original programs with listings and instructions for $5. SAE for details and free program. 1/48 Carrington Rd, Waverley NSW 2024.

FOR SALE: SYM-1 plus KTM2/80 and BASIC. $450 Ring Salvatore after 5.30 pm (02)660-5120.

OSI CHALLENGER: 1P, with 8K RAM, RS232 interface, documentation and packaging. 1979 model, good condition, and goodwill included — $520. Paul Webster, (02)55-6125.

SELL: TRS-80 48K disk, ITOH printer, Hires graphics, l/case, $1500+ software, $3750. Bob Milutinovic, 5 Cooper Avenue, Moorebank NSW 2170. (02)601-4590 ah.

FOR SALE: Exidy Sorcerer 32K with $300 worth of software for $1200. Phone Victor (03)44-4436.

SORCERER: Save BASIC variables to tape (also Load) Z=USR(SV[UNIT] ‹variable name›) Also LV and execute Monitor commands. (e.g: printer ON/OFF). $7.00 cass. 18 Essington St, Flagstaff Hill, SA. (08)270-2940.

OSI SUPERBOARD 8K RAM, 5 amp power supply, software. Am upgrading to disk. $300.00 ono. Ed Pinder (063)37-5303, P.O. Box 603, Bathurst NSW 2795.

DEVELOPMENT PAC for Sorcerer computer. As new, complete with manual and improvement software, $110. Ring (02)633-4915 after hours.

SELL: Quality West German 240 V Caramant CCTV. HF/RF and direct video output, positive or negative. Not quite working but is repairable. Working 5-inch B/W monitor to suit. Best offers. (03)598-5679.

WANTED: Home computer, any type considered. Not necessarily in working order. P.O. Box 68, Aspley Qld. 4034.

SELL: TRS-80 Level II, 16K RAM recorder, monitor, keyboard, all Tandy. Includes extensive range of software. Best offer. Wayne Schmidt (054) 43-0695, 5 Berry St, Moama NSW 2739.

SINCLAIR ZX80 with 4K and 8K ROM, assorted programs, special modifications and ZX80 and ZX81 manuals. Almost new, $260. (03)232-6410.

RCA COSMAC VP-III microcomputer, almost brand new, up and running with manuals. Paid $160, sell $90. Phone Tim, Perth (09)386-1666.

SELL: ZX-80, 8K ROM, 4K ROM, 16K RAM, cassettes, manuals, etc, worth over $500, sell $400. Lutheran School, Waikerie, SA (085)41-2344 or (085)41-2375 ah. (Ric Kube.)

APPLE TWO PLUS: Colour monitor, 48K RAM, disk drive and software, $2600 ono. Phone (03)873-3820 after 7 pm Terry.

SELL: 240/110 V 100 W transformer, $30. Minisprite 80 mm 110 V cooling fan, $15. 5 V 4 amp power supply (110 V input), $60. All ex OSI computer. W. Geary, 83 Second Ave, Rossmoyne 6155. (02)457-8809.

Sansui follows up the widely acclaimed Super Feedforward System with yet another breakthrough.

The Super Feedforward System is a remarkably effective amplifier circuit developed by Sansui and first introduced last year in the widely acclaimed AU-D11 and AU-D9.

Combining a standard negative feedback loop with an error-correction feedforward circuit, it successfully reduces to the very threshold of measurability all types of distortion—including all traces of switching, crossover and TIM.

So how is Sansui improving on this? Easy. We're introducing *two* new competitively-priced Super Feedforward amplifiers, models AU-D33 and AU-D22, along with a matching tuner, model TU-S33. This technological breakthrough means that now anyone can put together a stereo system built around a versatile, high-performance Super Feedforward amplifier.

We invite you to compare the distortion figures of either amp against any others on the market. And when you do, remember that Super Feedforward reduces or eliminates *all* types of distortion, not just harmonic or switching or TIM.

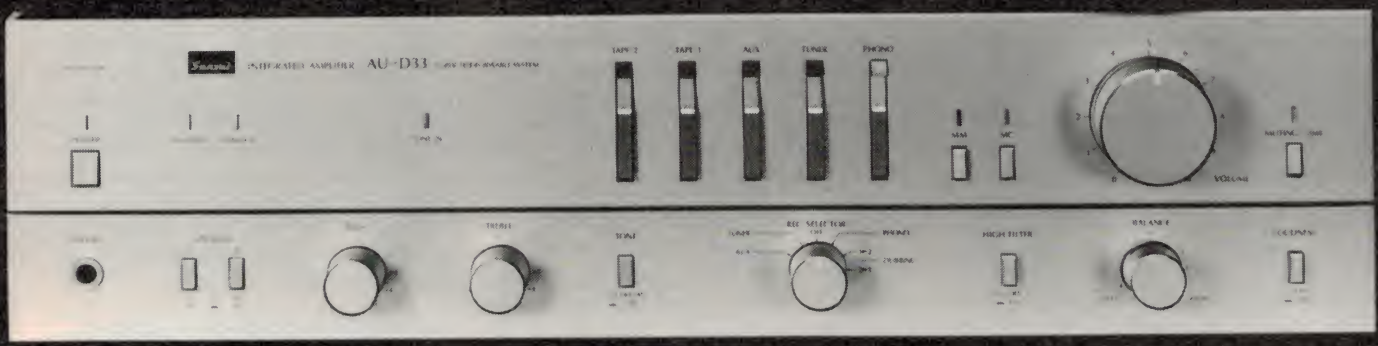
We're confident that you won't find smoother or purer sound at any price. Sansui, a leader in audio engineering for 35 years.

AU-D33: 50 watts/ch., min. RMS, @ 8 ohms, 20 to 20,000Hz with no more than 0.004% T.H. distortion.
AU-D22: 35 watts/ch., min. RMS, @ 8 ohms, 20 to 20,000Hz with no more than 0.006% T.H. distortion.
TU-S33: FM Servo-Lock tuning system for drift-free reception.

THE END OF DISTORTION DISPUTES.

Super FF

TU-S33



AU-D33

(Also available in black finish)

SANSUI ELECTRIC CO., LTD. 14-1 Izumi 2-chome, Suginami-ku, Tokyo 168 Japan
VANFI (AUST.) PTY. LTD. 297 City Road, South Melbourne, Victoria 3205, Australia Tel: 690-6200
283 Alfred Street, North Sydney, N.S.W. 2060, Australia Tel: 929-0293

The Sansui SE-8 graphic equaliser/analyser

An innovative solution to a common acoustic problem — equalisation. This unit "... comes closer to the amateur's expectation of a panacea than anything else ... yet seen in the market place."

Louis Challis

IT IS OFTEN perplexing how many pieces of equipment developed for laboratory use over the last two decades have found their way into the consumer electronic market. Much of this equipment may be treated as a gimmicky approach to create a demand where none actually exists, but in certain cases it is practical equipment to truly assist the novice in areas which were previously regarded as the domain of the professional.

One such piece of equipment has unquestionably been the graphic equaliser; another has been the real time spectrum analyser. When the two are combined in one instrument they have the potential to become a truly effective and useful tool to assist in one's day by day work or play with audio equipment.

I saw my first equaliser about 18 years ago in the form of a one-third octave band spectrum shaper for use with laboratory set-ups to measure vibration. That particular piece of equipment was developed by General Radio, and provided a very effective means of frequency equalisation as part of a dedicated piece of equipment for use with a military environmental test set up. It featured such innovative extras as a key locking system, to stop some unwanted person from changing the predetermined spectrum shape (many home equalisers could do well to incorporate a similar feature to hold knob-twiddling children at bay!).

In the following ten years many consumer electronics firms have seen the benefit of this linear spectrum display approach, which provides an optical analogue of the filter frequency curve. By selecting octave band centre frequencies the simplest and yet most convenient graphical display is superimposed on one's interpretation of the frequency response of the filter curve so produced. There are today, needless to say, many hundreds of graphic equalisers, some of which offer good performance and a few exceptional performance.

Real time display

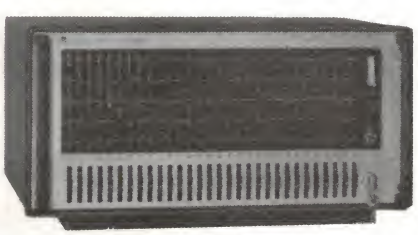
I saw my first real time analyser about twelve years ago. It consisted of a rather large cathode ray tube display unit seated on top of a large box of electronics, with the combined height in excess of 800 mm, a weight something in excess of 50 kg and a cost tag sitting somewhere round about $12 000, which was a lot of money in those days! This equipment was designed for acoustic research and was highly regarded by most of the competing manufacturers.

It did not take long for the high fidelity industry, and most particularly the recording segment of that industry, to realise the benefits that such a device could provide. The greatest benefits were achieved in the frequency equalisation of electro-acoustic systems and for checking the frequency characteristics of studios. This could be carried out with great ease and practicality and so the need, benefit and advantages of producing lower cost versions of the same equipment were realised. These versions had less restrictive parameters, lower performance and generally much lower price tags. By reducing the quality and accuracy of the filter networks it soon became possible to produce devices that used even simpler displays and yet still provided adequate performance for equalising an electro-acoustic system, measuring the overall performance of the resulting system, and more importantly for equating the objective parameters with one's subjective requirements.

Obviously, the graphic equaliser and the real time octave or one-third octave band analyser were often used together to perform the function of frequency equalisation and objective assessment. They were always produced as separate pieces of equipment.

Graphic display of power level settings or inputs has become the vogue in certain high-priced amplifiers over the last five years, generally in the form of a graphic display using light emitting diodes.

One innovative model, which aimed at achieving the same result with a combined spectrum analyser, was released earlier this year by Sansui in their B77 amplifier. Not surprisingly, when this unit hit the market I borrowed an example from the local Sansui agents (Vanfi) to evaluate in our laboratory. It has reposed there for some six months now, during which time we have made use of its special merits and its now well-proven attributes. The electronics that went into producing the real time analysis feature of that particular amplifier have formed the basis of the Sansui SE-8 Octave Band Graphic Equaliser. By combining a well-proven real time analyser design into a box containing two octave band equalisers Sansui has, in our opinion, achieved a positive breakthrough in graphic equaliser design.



The first equaliser I ever saw was this ⅓-octave band spectrum shaper made by General Radio. It featured key-locked controls.

The SE-8

The SE-8 stereo graphic equaliser, which is available in black or silver brushed satin fascia versions, contains the two equaliser sections on both sides of a central spectrum analyser unit. Each of the graphic equalisers contains the conventional slider controls for octave band centre frequencies of 32 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz and 16 kHz with a genuine ±12 dB range. These controls may be set so that any individual filter can achieve a nominal ±12 dB setting relative to the zero setting, or +24 dB relative to the −12 dB setting, if a range adjustment greater than 12 dB is required.

Thus, for example, if all the controls are placed at −12 dB and one or more controls requires a boost of up to 24 dB, this is acceptable and is a feature of the basic design.

In the centre of the display panel is a window, behind which is a ten-band spectrum analyser with a 21 dB total display range with eight steps, each of 3 dB. The analyser uses a bright blue plasma display with an exceptionally rapid response and yet far more modest cost than that provided by either a LED display or the far more costly cathode ray oscilloscope type of display. The plasma display is perfectly suited for the task and performs very well.

In the quadrant immediately below the plasma display are two rows of controls, with the top row providing a power on/off switch, an uncalibrated analyser level setting potentiometer and tape monitor switches for tape one, tape two or source. The bottom row of controls contains a spectrum analyser switch for left channel, right channel or peak hold on the left. On the right hand side is a graphic equaliser defeat switch or ON switch and a recording switch. This recording switch should be used when a signal coming in at the input is to be re-equalised before being set to either tape recorder 'one' *or* tape recorder 'two', or from tape recorder 'one' *to* tape recorder 'two' at the output. On the rear of the unit, stereo pairs of RCA-type coaxial sockets are provided for input, for record and playback for tape recorder 'one', record and playback for tape recorder 'two', and output sockets for left channel and right channel respectively. The unit is fabricated from steel and is well made.

The inside of the unit contains one large 'mother' board, with the equaliser control circuitry for left channel and right channel all located together on one side of the board. This features thirteen integrated circuits, its own power supply stage on the left hand side of the board, and a protection circuit at the rear. The selector stage for switching between the stages of the unit are all placed in the middle of the board. Immediately above the front of this board the real time spectrum analyser display and control board are located.

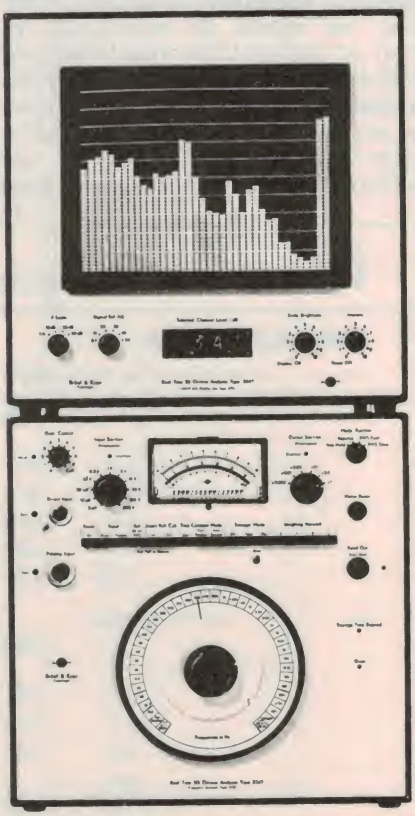
The plasma display is directly wired onto this board and is mechanically protected by additional metal covers. There is still enough space left within the module to accept a medium sized power amplifier, as well as various types of preamplifier. One really wonders if the whole of the unit could not have been effectively reduced in size to achieve a neater and more compact product.

On test

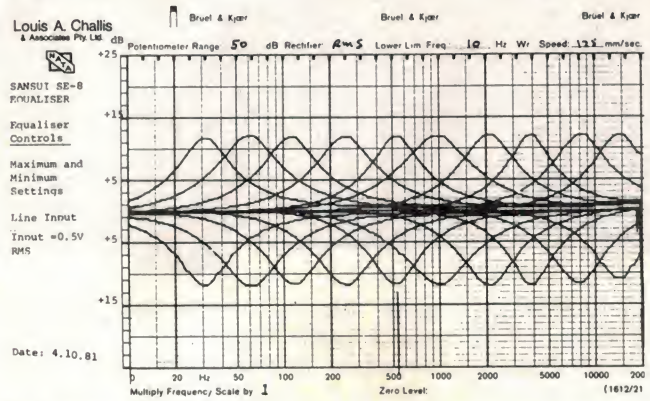
The objective testing of the unit proved to be an eye-opener. The frequency response is extremely flat, extending from 2.5 Hz at the lower frequency limit to beyond 100 kHz at the upper 3 dB point (with the tone control centred). With one volt input (and one volt output) the distortion figures are exemplary, being less than 0.008% at 100 Hz, less than 0.007% at 1 kHz and 0.01% at 6.3 kHz. At the rated nominal maximum output of 4 volts these figures only increase slightly to a still satisfactory value of less than 0.02% at 100 Hz, 0.015% at 1 kHz and 0.016% at 6.3 kHz. The maximum output voltage at clipping point is a phenomenal 59 volts RMS, which indicates that this unit would readily be used as a high-level equaliser, feeding directly into power amplifier output stages without distress. Another outstanding feature is the hum and noise level, which is −99 dB unweighted, relative to the 1 volt output, and a phenomenal −110 dB(A) relative to that same level.

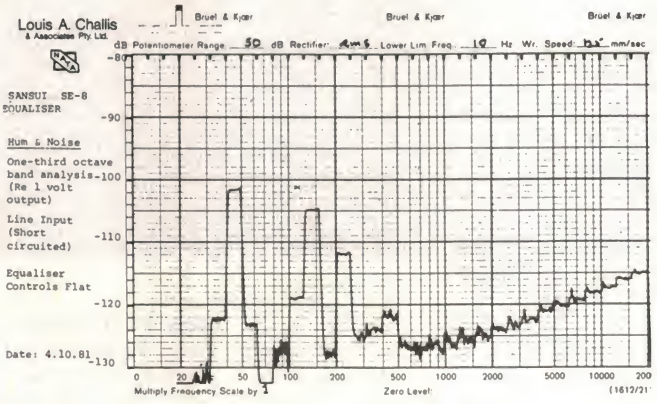
The transient intermodulation distortion is also extremely low, being less than 0.01% with the standard 3.15 kHz square wave and 15 kHz sine wave mixed in a four-to-one ratio.

The separation between channels is extremely good, and the highest level that is fed through from channel one to channel two (left to right or right to left) is at a −71 dB level at 20 kHz when compared with the fundamental in the main channel. ▶



A real-time analyser – expensive!





To hear

The objective tests were positively impeccable, but we were keen to see how the unit would perform in subjective tests. Anybody who has ever tried to use a graphic equaliser knows that without effective metering or monitoring instrumentation facilities it is hard to tell by ear alone whether one has really achieved the optimum balance setting.

The difference between this unit and others currently available is that it is able to provide a direct visual assessment of what has been achieved. This may be on either real programme content or alternatively using a preferred broadband electronic white noise test signal. By monitoring the input or output of the signal displayed on the octave band plasma display you can see directly what the characteristics are and take the appropriate corrective action (within the physical and practical capabilities of the octave band equalisers). There can be no denying that octave band equalisers are not the most refined means of achieving spectral balance adjustment, but for the majority of residential situations and within the scope of what the majority of amateurs are looking for, it provides the best compromise between cost and performance. In listening to programme content, equalising tape recorders and adjusting the spectral balance of signals feeding to loudspeakers of less than perfect performance, I found that *the Sansui SE-8 Equaliser comes closer to the amateur's expectation of a panacea than anything else I have yet seen in the marketplace.*

Whilst the equipment can equalise out the majority of problems (but not all) in amplifiers, tape recorders and loudspeakers, I did not find that it is capable of providing perfect correction for room acoustics or room standing waves (eigen tones). The Sansui SE-8 may not, in the end, be a true panacea, but it offers a more innovative solution and more other practical features than almost any other piece of equipment that has yet been produced that is not a professional spectrum analyser combined with a professional graphic equaliser. ●

SANSUI GRAPHIC EQUALISER TYPE SE-8

Dimensions:	*430 mm wide, 130 mm high, 277 mm deep.*
Weight:	*4.4 kg*
Price:	*$499 rrp*
Manufactured:	*In Japan by Sansui Electric Company Ltd.*
Distributed by:	*Vanfi (Aust.) Pty Ltd, 297 City Rd, South Melbourne Vic. 3205. (03) 690-6200.*

MEASURED PERFORMANCE OF SANSUI GRAPHIC EQUALISER SE-8 S.N. 831070624

HARMONIC DISTORTION:

(A) (At Rated level of 4 Volts output)

	100Hz	1kHz	6.3kHz
2nd	-76.7	-91.6	-88.6dB
3rd	-80.2	-77.1	-76.4dB
4th	-85.7	-	-dB
5th	-88.0	-	-dB
THD.	0.019	0.014	0.016%

(B) (At 1 Volt output)

	100Hz	1kHz	6.3kHz
2nd	-83.5	-84.1	-81.3dB
3rd	-89.2	-96.1	-85.4dB
4th	-94.8	-	-91.7dB
5th	-	-	-dB
THD	0.0077	0.0064	0.01%

TRANSIENT INTERMODULATION DISTORTION: Very low: less than 0.01%
(3.15kHz square wave and 15kHz sine wave mixed 4:1)

NOISE & HUM LEVELS:
re 1 Volt output) LINE -99dB (Lin) -110dB(A)

MAXIMUM OUTPUT VOLTAGE AT CLIPPING POINT:
59 V RMS

FREQUENCY RESPONSE:
(-3dB re 1 Watt, O.5V Input to Aux)
Equaliser Tone Controls Centred
Left 2.5Hz to >100kHz
Right 2.5Hz to> 100kHz

SENSITIVITY:		Left	Right
(controls flat)	LINE GAIN	0dB	GAIN 0dB
INPUT IMPEDANCE:		Left	Right
	LINE	32k Ω	32kΩ

OUTPUT IMPEDANCE: 480 ohms (@ 1kHz)

Say it again, Sam

Amateur radio 'field days' are regular events on radio club calendars. Generally they're for getting together and having fun with various competitions, etc, looking at trade displays, selling/buying junk — all with the object of raising money for the club.

It is traditional at ham radio field days to include a few 'events' to amuse the ladies — generally referred to as YLs or XYLs (all this is horribly sexist — never become involved with a ham . . . Ed's wife). Topping the list of ladies' events at every field day is the 'Ladies Radio-Throwing Contest'. A little something to relieve the frustrations of playing second fiddle to the transceiver, no doubt.

This time-honoured event appeared on the agenda of a certain club field day attended by the Editor recently. To advise competitors of impending events, and to broadcast announcements, etc, the club had organised a PA system and had rostered various announcers.

Came the appointed time for the Ladies Radio-Throwing Competition. An announcement was duly made, but, it seems, the response was not immediate so another announcement was made. It seems this too was missed (or likely, ignored) by the populace.

At this stage, for one reason or another, the announcer appeared to become somewhat flustered. He was doubling as events scorekeeper as well and he was attempting to record the results of the previous event, which had run late, and start the next — the Ladies Radio-Throwing Competition.

The next announcement came out as the "Radio Ladies-Throwing Competition . . ." and he was swamped with entrants — all men, wanting to know where the ladies were for throwing!

DREGS

IT'S SOME TIME since we had computer cracks in these columns, so it seems appropriate to launch Dregs this month with a software joke — only it's more irony than joke.

The latest computer language to storm the bastions of the software computerists (now **there's** a buzzword for you!) is called 'FORTH'. FORTH is reputed to be not only cunningly devised but powerful to boot (. . . if you'll pardon the pun). You start out with a 'core' and build out your FORTH as you go — new instructions are added as you use it. FORTH defines new instructions in terms of existing instructions and a huge branch network multiplies from the 'core'.

Which Bible character is alleged to have said "... go forth and multiply . . ."?

Enter the state of higher fidelity with the new Walkman 2 stereo player, the world's smallest Hi-Fi. It's a sensational way to listen to music on cassettes and raise your awareness of sound. Walkman is so light it practically feels weightless. So small it's hardly bigger than the plastic case that cassettes come in. And so personal, with headphones that weigh next to nothing, that HiFi has never been more intimate.

The new Sony Walkman. It can make your experience of sound infinitely wondrous.

The World's Smallest HiFi

WALKMAN

Walkman is a registered trade name of Sony

SON 0114

THE IDEA BEHIND OUR RADIO CASSETTE RECORDERS.

The stereo headphone represents perfect stereo reproduction.

As well as receiving sound through your ears, you appear to receive sound from above your head.

This added dimension in sound is stereo.

Of course, anyone can get this sound from any good stereo radio cassette recorder if they listen through stereo headphones.

But, at JVC, we realised it was impractical to wear stereo headphones all the time.

So we invented a new kind of sound system just for our stereo radio cassette recorders.

The Biphonic System.

This exclusive system offers 3-dimensional sound effects, so you enjoy true stereo reproduction without headphones.

If you'd like to know more about the many innovations JVC has brought to the stereo radio cassette recorder, write to us for a brochure, or call in to any JVC dealer.

Then you'll see why JVC equipment is recognised as The State of the Art.

JVC

JVC0058/ETI/FMMH

JVC Advisory Service, Private Bag, Kingsgrove, N.S.W. 2208 or phone (02) 750 3777.